Botanical Gazette

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BOTANICAL GAZETTE

JANUARY, 1892.

On the relations of certain fall to spring blossoming plants.

AUG. F. FOERSTE.

(WITH PLATES I AND II.)

Most spring flowering plants in the more northern latitudes begin the development of their floral organs already during the previous year. The following table will give a very good idea of the extent to which this development has taken place in a series of plants collected near Clarendon, Vermont, during the week from the twenty-second to the twenty-eighth of August. In this list are inserted two plants: *Cypripedium parviflorum* Salisb. collected near Ludlow, Vermont, on the twenty-seventh of September, and *Chimaphila maculata* Pursh, found near Andover, New Jersey, on the ninth of October. The first column indicates whether the scaly winter-buds are subterranean (S), subaerial, or chiefly covered with fallen forest leaves or surrounded by moss (SA), or aerial (A). The second column gives the regular flowering season. The third records the length (in millimeters) attained by the flower cluster at the dates when examined. In the case of *Arisaema triphyllum* Torr. the length of the spathes was given instead (S). The fourth column records the size of the largest flower bud in these clusters. In two cases measurements were not recorded (d).

Hepatica acutiloba DC.	S	Mh. Ap.	——	1.50
Thalictrum dioicum L.	S	Ap. My.	2.3	.42
Actæa alba BIGEL	S	My.	d	d
Actæa spicata, var. rubra MICHX.	S	My.	2.5	.50
Caulophyllum thalictroides MICHX.	S	My.	2.5	.83
Waldsteinia fragarioides TRATT.	SA	Jn.	2.7	2.00
Mitella diphylla L.	S	My. Jn.	.8	.25
Gaylussacia resinosa TORR. & GR.	A	My. Jn.	.8	.17
Vaccinium Pennsylvanicum LAM.	A	My. Jn.	——	1.00
Epigæa repens L.	SA	Ap. My.	7.5	2.50
Pyrola elliptica NUTT.	A	Jn. Jy.	.8	.25
Pyrola secunda L.	A	Jy.	.8	.33
Chimaphila maculata PURSH.	A	Jn. Jy.	.7	.25
Asarum Canadense L.	SA	My. Jn.	——	2.50

Arisæma triphyllum TORR	S	Ap.	S. 2.5	d
Orchis spectabilis L	S	My. Jn.	6.3	2.50
Habenaria viridis, var. bracteata REICH	S	Jn.	4.5	2.00
Habenaria orbiculata TORR	S	Jn. Jy.	4.5	2.00
Goodyera pubescens R. BR	A	Jn. Jy.	.5	.10
Corallorhiza multiflora NUTT	S	Jy. Aug.	3.6	1.50
Cypripedium parviflorum SALISB	S	My. Jn.	——	8.75
Trillium erythrocarpum MICHX	S	Ap. My.	——	5.50
Clintonia borealis RAF	S	Jn.	3.0	1.75
Polygonatum biflorum ELL	S	Ap. My. Jn.	3.0	.75
Smilacina racemosa DESF	S	My. Jn.	2.5	.33

In Thalictrum dioicum the inflorescence was in a more advanced state of development than the leaves. The inflorescence of Waldsteinia fragarioides lies in the axil of the upper scales of the scaly bud, or of the lowest succeeding leaf. That of Mitella diphylla has a scaly covering of its own, in addition to the scales of the winter bud in general, to which it stands in the relation of a lateral bud. The inflorescence of Gaylussacia resinosa and Vaccinium Pennsylvanicum is found in the terminal and upper axillary buds. That of Pyrola elliptica, Pyrola secunda, Chimaphila maculata, and Goodyera pubescens is enclosed in a scaly bud which usually lies at the center of a cluster of leaves terminating the apparently flowerless stem; occasionally these buds lie in the axil of one of the upper leaves of the flowering stem.

This early development of the flower buds of the next season permits their ready appearance in spring. It will be noticed, however, from the preceding table that even flowers blooming as late as July and August may develop their buds during the previous summer. Occasionally plants mistake the cold winds of the earlier part of October for winter, and the warm, sunny days of Indian summer for spring. In that case the flower buds prepared for the succeeding spring are rapidly developed and perfected, only to be killed off again by the wintry winds of the following months, so that they fail to ripen their seeds. In addition to the list of plants enumerated at other times, the wild strawberry, *Fragaria Virginiana* Ehrh., was very frequently found in blossom this fall, so that thousands of flowering specimens could have been collected.

In quite a number of cases, when the flora of the whole world is drawn under consideration, plants which used to flower in the spring only have taken up the habit of flowering in the late fall, and have succeeded in ripening their seeds in spite of this habit. They were able to flower already in

the fall owing to the advanced state of development of their buds at this season, even before the habit of flowering in the fall set in. It was only necessary to secure means of perfecting their fruit. To illustrate these phenomena the writer has chosen the three plants having this habit which are most familiar to himself: *Hamamelis Virginiana* L. of the United States, *Hedera Helix* L., and *Colchicum autumnale* L., of Europe, a shrub, a vine and an herbaceous plant respectively, belonging to widely different families.

Hamamelis Virginiana, the witch hazel, usually flowers in October or November, but occasionally, after a cold fall, not until the ensuing spring. The flower buds appear very early, almost simultaneously with the leaves, perhaps, but search was not made for them at so early a date. The specimen figured was collected early in July. It will be noticed that the flower clusters are axillary (fig. 1.) The clusters consist usually of three buds closely arranged around the pointed termination of the little axillary stem (fig. 4.) Each bud is subtended by a small appressed bract which reaches about the same height as the buds; these bracts therefore do not offer full protection to the buds within (figs. 2, 3, 4.) Possibly the bracts completely enclosed the clusters formerly, when the witch hazel flowered only in spring. The defect is remedied by the subcoriaceous character of the exposed portions of the calyx, and the hairy covering to both the calyx and the subtending bracts (figs. 2, 3.) The early development of the flower cluster, its long period of extremely slow development, the subcoriaceous character of the calyx and of the bracts, the hairy covering of the same, all indicate rather a plant which once was obliged to protect its blossoms for spring flowering, than a fall plant which is developing into a spring blossomer, or a summer plant becoming a fall blossomer. The fruit remains small during the winter. It is very coriaceous in character, and in addition has a protection of closely-fitting hairs. Its real development begins first in spring, and the seeds are usually not ripened until late summer.

Hedera Helix, the European ivy, usually flowers in October, but in more southern countries as early as September. The writer has seen no record of its ever blossoming in the spring. It may therefore be assumed to be a plant which has entirely gone over from spring to fall blossoming. The young branches of the ivy do not all cease growth at very nearly the same

time, as is the case with so many trees and shrubs, but some of them are terminated with scaly buds, while others continue growth for several months, and may perhaps even have their tips winter-killed. Terminal scaly buds were noticed at Heidelberg, Germany, as early as June 1, although the date of their first appearance is uncertain. They had every character of an aerial scaly bud destined to survive the winter (fig. 14.) Perhaps the scales were a little too green, not at all coriaceous enough, but formerly while the plant was spring blossoming the case might have been different. Not a trace of an inflorescence was noticed in these buds until the first days of July. Near the middle of the month the inflorescence was quite large in all of the flowering buds, and during the last days of July the inflorescence was rapidly pushing its way out of the scaly bud into the open air, and expanding preparatory to fall flowering. The upper scales of the scaly bud are usually carried up on the common peduncle of the inflorescence to a greater or less extent (fig. 15.) The formation of a scaly bud at an early period, at a time when the leaves have almost reached their full growth, and the quite slow gradual development of this bud, are characters perfectly incomprehensible in a summer-flowering plant, taking up the habit of blossoming in the fall, but are readily understood if the plant be supposed to have changed from a spring to a late autumn-flowering plant. The ivy does not ripen its fruit until the ensuing spring. Its character during winter was not noticed.

Colchicum autumnale usually flowers in October, but when the meadows have been inundated in the fall, or when the fall has been unusually cold, it does not blossom until spring. The first trace of a flower was noticed at Heidelberg, Germany, about the middle of July, but it had evidently been in existence for perhaps a week. At the end of the month the flower bud was still minute. The specimen figured belongs to a much later date, just before the flowering season, and represents the developing blossom. As a means of presenting the morphology of this plant it is much better adapted. The bulb has one side considerably flattened, and the other decidedly convex (fig. 5); the lower portion of the bulb slopes obliquely downwards from the convex surface until it meets the flattened surface at an acute angle (fig. 5.) It consists of two withered, brownish scales enclosing the base of

the flowering stem which has developed into a corm. Removing the scales this corm is seen to give form to the bulb (fig. 6.) Along the middle of the flattened face there is seen to be a broad groove, and at its base there has been developed a sort of lobe. To this lobe is attached a bud (fig. 8), which is really in the axil of the inner of the two withered sheathing scales just removed. If at a sufficiently advanced stage of development the thin cuticle at the base of this bud be removed it will be found to completely cover a large bundle of little roots, many of them already 3 mm. long (fig. 9), ready to take the place of the old roots when their work is done (fig. 5.) A reference to the figures will show that by a more rapid development of the tissues just above the roots on the non-attached side of the bud, this bundle of roots becomes central in the oblique base of the future bulb (figs. 5, 7.) The first scale is a closed sheath (fig. 9.) The second scale is a sheath only at its base, but the sheathing portion elongates considerably during subsequent growth (fig. 10.) The first leaf is also slightly sheathing at the base (fig. 11), and the second leaf is not sheathed at all (fig. 12.) In the plant figured the floral envelopes, the stamens, ovary and styles are all already considerably developed (fig. 13.) It will be noticed that a small internode exists between the second scale and the first leaf (*a*, figs. 11, 12, 13.) When the plant begins to flower in the fall the bud pushes its way along the afore-mentioned groove (fig. 8), and up between the withered sheathing scales to the air. This is mainly caused by the growth of the scales of the bud (figs. 9, 10) of the perianth tube, and of the styles of the flower (fig. 13.) The leaves and ovary do not appear until the next spring. At this time the internode between the second scale and the first leaf (*a*, figs. 11, 12, 13) develops rapidly and carries both the leaves and the fruiting ovary out into the open air, thus solving the question of the proper wintering of the fruit. The nondevelopment of the leaves and fruit until the year following the flowering season is certainly not a character such as might be expected from summer flowering plants turning gradually into autumn or spring flowering ones. However, the appearance of the flowers before the leaves is readily intelligible if the reverse change from a spring to a fall blossomer be supposed, since this is not at all an uncommon occurrence in spring flowering plants, and such a forced development of the flower buds before the lower

leaves is often already indicated in the scaly bud of spring flowering plants during the previous year. It is only one of the extreme results of that tendency which certain plants have of flowering as early as possible, and hence of becoming spring and occasionally fall blossoming plants.

Late fall flowering plants may be divided into two classes. First, those which have developed from summer flowering plants by the increase in the number of internodes, with their appendages, or the gradual retardation of growth. Second, those which have developed from spring blossoming plants by the premature development of buds destined to flower first during the ensuing spring. The first class never had any need of protection to the flower buds against wintry weather, and hence should form no scaly buds for the flowers; moreover, since their flowering buds never lay dormant during the winter season, they should show no traces of a period of rest, between the first growth of the flowering buds and their final development. The second class should preserve traces of a scaly bud, and should show traces of great retardation of growth between the first rapid starting of the flower bud and the final rapid completion of the same, as reminiscences of their former almost dormant state during winter. Moreover, the first class should find all their nearest relatives among the summer flowering plants, and the second class should have their nearest relatives among those which flower immediately in the spring. This is the case with the list of fall flowering plants at hand; since, however, this list is only collected from literature, and the writer has not personally examined the plants in a state of nature, a further discussion of the same is omitted for the present.

That spring blossoming plants are the offspring of summer flowering plants, and that they have obtained the power of flowering so early by decreasing the number of their internodes and by starting the development of their flower buds during the previous year is a well known fact. This is further indicated by the fact that spring plants grade by intermediate species into early and late summer flowering plants. If there are related species flowering in the fall, and they belong to the first class above described, a series of intermediate early and late summer flowering plants is sure to be observed. If a spring flowering plant has close relatives among fall blossomers, and none whatever during the inter-

mediate summer months, the development of the fall flowering species from those blooming in spring, in the manner described above, is very likely to be the case. As a matter of fact, most fall blossoming plants belong to the first class.

The ideal time for the flowering season of plants is in late spring and early summer. In the struggle in the race for existence two tendencies set in. The one is to secure advantage over surrounding plants by increasing in size and thus securing more light, air and room for the development of their own flowers. This tends to result in late summer and in autumn flowering plants. The other is to gain advantage over other plants by the earlier blossoming of their flowers, or by blossoming before the foliage of the trees overhead, or that of the surrounding plants can cut off the light or otherwise interfere with their development. This tends to produce spring flowering plants. Autumn blossoming plants, which are the result of the extreme development of the latter principle, are in one sense of the term freaks of nature. The writer believes, however, from a study of the literature of the flowering seasons of plants, that this freak of fall flowering has become a permanent one for a greater number of plants than botanists usually suppose, and that there should be recognized a distinct division of fall flowering plants whose nearest relatives are with those that blossom in the spring.

If the principle that spring flowering plants are produced from summer flowering plants by the reduction of their internodes, be kept in view, it is evident that this result might be attained through the struggle for light and room *in situ*. The same result would be attained if summer plants should migrate temporarily toward the north, or up mountain sides, since the shortening of the period favorable for vegetation might operate in reducing the number of internodes and in hastening the perfection of the flowering buds, while after these alterations had become permanent, a return to more congenial climates would favor earlier, possibly spring blossoming. Essentially the same conditions would exist *in situ*, if the colder climate of a glacial period should come down from the north. The reduction of the period favorable for floral development would again operate in reducing internodes and in hastening the development of floral buds. The retreat of glacial climate would favor earlier blossoming, in many cases spring blossoming. Plants which were spring blossomers in the far

north before the advance of the glacial climate might be forced during its advance to migrate southward to maintain their existence, and on the retreat of the same might climb up the mountain sides and remain there as witnesses of their former migration. Moreover, plants which formerly had been spring blossomers might during the advance of glacial climate maintain themselves *in situ*, by adapting themselves to the more rigorous climate. On the retreat of the glacial conditions they might have so altered their habits as to be able to maintain their existence only on mountain tops or in the distant north. Migration to these places would therefore set in. It is probable that all these causes have operated in the production of spring blossoming plants. It is impossible to tell in the case of individual plants, to which method their production is to be ascribed. It is sufficient for the present to remember that nature has many means of accomplishing the same result.

Heidelberg, Germany.

The effect of mechanical movement upon the growth of certain lower organisms.

H. L. RUSSELL.

The effect of external agencies upon the growth of organisms has been thoroughly studied in several of its relations. Of these influences, the relation of temperature to growth, is perhaps the best understood. Other factors, such as the effect of light, of increased and diminished pressure, have also been made the subject of more or less careful study.

To the effect of mechanical movement upon the growth, less attention has been given, nor have the results already obtained been entirely in harmony with one another.

In the following experiments an attempt has been made to find out; (1) what influence mechanical movement has upon growth of cells in regard to size and form; (2) its influence upon growth in regard to increase in number.

The method used in the experiments was as follows:

Two 500 c. c. distilling flasks were half filled with nutrient solutions, sterilized and then inoculated with a small quantity of the germ to be studied. After thoroughly distributing the

inoculated "seed" by shaking, a number of samples were taken and from these the number of cells in a certain volume was determined by means of Nachet's hæmacytometer. By means of this apparatus equal known quantities were used each time. A number of counts, usually not less than one hundred, were made, so as to make the average as accurate as possible. At first each flask was inoculated and counted separately, but it was soon found that more accurate results could be secured by determining the number present per unit of volume for the whole amount of the fluid and then dividing it into two equal amounts. The danger of contamination from outside influences is of less consequence than the difference in units of volume which inevitably occurs where the determinations are made separately of the amount of "seed" added to each flask. After counting, the two flasks were subjected to exactly the same conditions, with the exception that one of them was kept in a state of constant agitation.

This was secured by the rotation of a vertical shaft to which was attached a horizontal bar. This bar in its rotation struck and lifted the flask, which on its return swing struck against an upright standard. The stroke by the rotating bar and the sudden checking of the movement of the flask kept the fluid in a state of constant agitation. All points of contact of the flask with the bar and standard were sheathed with rubber to prevent breaking. The power was furnished by a small reaction water wheel and was transmitted by a belt from a pulley on the motor to a cone pulley fastened to the upright revolving shaft. This cone pulley enabled me to vary the rapidity of the revolution of the horizontal arm at pleasure.

After allowing a certain time for growth, samples were withdrawn and counted in the same way as before. The number per unit of volume at the close of the experiment divided by the number per unit of volume inoculated as "seed" gives the ratio of increase for each flask. As a check, the solution was sometimes filtered and the organic substance carefully collected, dried, weighed, and the ratio thus determined. For this, the ash constituent of the cells can be neglected without interfering materially with the accuracy of the results.

In the majority of the experiments, *Monilia candida*, a yeast-like germ capable of inducing alcoholic fermentation in most sugar solutions, was used for the tests. Two other

germs, *Oidium albicans* and *Saccharomyces mycoderma*, were also used in various cases to confirm results.

To determine the effect of movement upon the size and form of the cells, an experiment was made with Oidium albicans in a bouillon culture. This germ when grown in this culture medium in the ordinary way forms two types of cells, one of which is a long, slender, hypha-like filament, and the other, a short, oval, or oblong yeast-like cell. As a rule, the growth mass is more or less gelatinous, the jelly-like consistency being due to the intimate intermingling of the elongated cell type. Where the short type of cells prevail, the vegetative mass in the bottom of the flask is of a more sandy nature. Two flasks were inoculated with this germ and subjected to similiar conditions except that one of them was kept in a state of constant movement while the other was left undisturbed.

The results obtained were as follows: in the still flask, the two types of cell structure were present in the usual proportions, and a wide variation was found in the yeast-like cells. These varied from 4×8 μ wide to 7×14 μ long. In the shaken flask no true hyphal filaments were found, such as were present in ordinary cultures. The nearest approach to true filaments were several chains of 4–6 slightly lengthened cells. The cell-contents did not differ materially in samples taken from each flask.

Much less variation in size was found among the cells of the shaken flask than in the other one.

The experiment was repeated with Saccharomyces mycoderma, a mycelium-building yeast. With this germ, the time of incubation was extended until quite a thick veil or membrane had formed over the surface. The still flask showed two types; one a submerged form, slender in outline, about $0.85 \times 2.25\,\mu$, and the other a surface form with vacuolated contents and plumper outline, averaging $1.2 \times 2.5\,\mu$. In the flask which was kept in motion there was a greater variation found in size, but that was owing to the large number of young daughter cells that had broken away from the mother cells before maturity. The mature cells were quite uniform in size, broadly oval in form, and almost all highly vacuolated. The average size was $1.25 \times 2.25\,\mu$.

From the above experiments it would seem, first, that incessant movement tends to prevent the formation of true hyphal filaments, although elongated types of cells are found;

second, that with the germs forming torula-like cells but little difference in size and shape can be produced. What difference there is seems to be caused not so much by the agitation of the fluid as by the exposure of the cells more freely to the influence of the atmosphere. When submerged the cells grow slender, with homogeneous contents, while the surface-grown forms were highly vacuolated and more broadly oval. The cells from the shaken flask agree in all essentials with those grown at the surface of the still flask, except that they averaged somewhat larger in size.

The second series of experiments bears upon the influence of mechanical movement upon the increase of cells. Horvath[1] conducted a series of experiments upon bacteria and their relation to movement, in which he found that mechanical movement interfered materially with the growth of the germs. From this he made the sweeping generalization that movement had a retarding influence on the growth of all lower organisms. Hansen[2] investigated the subject in connection with his work on yeast (*Saccharomyces cerevisiæ*) and found the reverse to be true. The germs increased two to three times faster when agitated than they did when grown at rest. He concluded that it was the agitation of the cell itself, aided possibly by the more minute subdivision of the nutritive materials, that enabled it to increase more rapidly. The introduction of air into the fluid by the apparatus he used was so little that he thought this point was not of much importance.[3]

In the following synopsis of results, A in all cases represents the culture agitated and B the one that grew undisturbed.

NO. OF EXP.	KIND OF GERM.	HOURS OF GROWTH.	NO. OF GERMS PER UNIT OF VOLUME.		PROPORTION SHOWING RELATIVE INCREASE IN NO. OF CELLS.	RATIO BETWEEN A AND B.
			BEFORE EXP.	AFTER EXP.		
AI. BI.	Monilia candida.	94	16.9+	2332 1618	1:138 1: 95	1.45+
AII. BII.	Oidium albicans.	48	4.67+	1262 610	1:270 1:130	2.0+
AIII. BIII.	Monilia candida.	70	24.4+	1087 767	1: 44+ 1: 31+	1.41+

[1] Horvath: Pfluger's Archiv f. d. ges. Phys. XVII, 125.
[2] Hansen: Medd. fra Carls. Lab., I, 271.
[3] Hansen: Hypothèse de Horvath, Medd. f. Carls. Lab., I, 96, French résumé.

The culture solution used in all cases was a 10 per cent. solution of grape sugar to which 1 per cent. peptone had been added. The above results indicate without exception that those germs which were agitated increased from 1.4–2 times as fast as those grown undisturbed. As a check upon the counting process, determinations of the dry matter present were made by chemical analysis at first.

Exp. III, which showed a ratio between A and B of 1.41 by the counting process gave by chemical analysis the following result. Amount of organic matter formed in A_{III} 0.1778 gm.; in B_{III} 0.1293 gm. Ratio between A and B 1.37+. This proves that the counting process is reasonably exact as it agrees quite closely with the chemical analysis. This is only true however where there is general uniformity in size of the cells.

The amount of alcohol which was produced by this germ when subjected to these different conditions, was also determined in a number of cases. In every case where this was made, a considerable increase in amount of alcohol formed was found in the undisturbed culture (B) over the agitated culture (A). It would seem then that agitation exerts a favorable influence upon the formation of cells but a retarding effect upon the products of fermentation. Both of these processes, growth and fermentation, depend directly upon the kinetic energy of the plant organism. Where katabolic processes are manifested more strongly in fermentative action there seems to be less energy used by the plant in growth. The data of the two following experiments with Monilia candida, giving the highest and lowest proportions found by analyses, illustrate this point.

NO. OF EXP.	ALCOHOL FORMED.	INCREASED GROWTH OF SINGLE CELL.	RATIO.
A_V B_V	1.6% 3.2%	335 109	
Proportion.	1 : 2 :: 3.07 : 1		6.14
A_{VI} B_{VI}	3.2% 3.8%	44 31	
Proportion.	1 : 1.18 :: 1.41 : 1		1.66

It will be noted that while no uniformity seems to exist in the ratio, the *amount* of *fermentation products* of the cells in B is *always* greater than in A, while the *amount of organic matter* formed stands in an inverse relation.

We may now ask what is the cause of this increased rapidity of growth when agitated. The experiments detailed above allowed considerable aeration during the movement and as this factor seemed most prominent, the experiments were repeated in such a way as to increase the aeration and diminish as much as possible the movement of the fluid. If aeration increases the growth of the organisms, there should be an increase in the ratio between A and B.

Exp. I. An Esmarch's coiled glass tube, such as is used in bacteriology for air determination in fluid cultures, was inoculated with Monilia candida and air drawn slowly through the coil by the aid of an aspirator. The small bubbles of filtered air slowly travel the spiral, so that a considerable quantity of oxygen ought to be absorbed by the liquid. In this way aeration is considerably increased while the movement of the fluid is much reduced. At the end of 42 hours growth, it was found that the germs which were aerated had increased 2.5 times as fast as the non-aerated culture.

Exp. II. A 500 c.c flask was partially filled with a nutrient solution and inoculated with freshly grown Monilia candida. The mouth of the flask was closed by a triple-perforated sterilized rubber cork. In two of the openings, glass tubes were inserted and the lower ends were drawn out into fine points. The third opening was closed by a bent open tube, the outer end of which was directed downwards. These glass tubes were closed with cotton-plugs and sterilized before being put in place. The two capillary tubes were connected to the blast of a filter pump and thus a stream of filtered air was forced into the fluid culture. The fine bubbles of air rising to the top of the fluid escaped through the bent exit tube. In 30 hours there was found to be 2.2 times as many cells per unit of volume in aerated flask as there were in non-aerated.

Exp. III. In both of the preceding experiments aeration was increased as much as possible while the movement was lessened. In this experiment the reverse order was followed. A thick glass tube was sealed at one end and at 5 cm. distance from this end, a large bulb capable of holding 300 cc.

was blown. In this culture bulb was placed some coarse sterilized quartz sand. The longer open arm was closed with cotton. The vessel was filled with culture fluid so that the bulb and a portion of the open arm was entirely filled. This apparatus was connected with the motor and so arranged that it revolved in as nearly a horizontal position as possible. The coarse sand inside acted as a distributor of the motion to the fluid causing it to be agitated thoroughly.

In this way the maximum movement was obtained with a minimum of aeration; the only chance for aeration being through the small opening of the open arm. Cultures of Monilia candida grown for forty hours and treated in this way had 1.4 times as many cells as those grown in undisturbed flasks.

It is practically impossible to get a considerable movement of the liquid without more or less aeration and the converse is equally true, but where aeration was increased in greater proportion than movement, as in Exp. I and II, we find the percentage of increase of cells and consequently of organic material to be much greater than in Exp. III, where aeration was diminished relatively more than movement.

This factor of aeration seems to be the predominant one although it is possible that the increase is not due to the action of any one factor alone. More intimate division of nutritive materials and the constant presentation of fresh food material to the surface of the plant cell probably aids in the increased growth.

Summing up the points discussed into concluding sentences, we may say that:

1. The form and size of fungal cells is but little influenced except in the case of hyphal filaments which seem to form with difficulty when subject to constant movement.

2. Constant agitation affects very strongly the increase in number of cells formed and consequently the amount of organic matter produced. The increase by growth in agitated cultures as compared with still-grown cultures ranges between wide limits but is usually 200–300 per cent.

3. The amount of fermentation products, as determined by the alcohol formed, seems to stand in an inverse ratio. All cultures so tested showed uniformly less alcohol in agitated than still cultures.

4. The cause of this more rapid cell-multiplication by mechanical movement seems to depend upon aeration of the

culture, the cells growing more rapidly in contact with atmospheric oxygen than when submerged.

5. While this appears to be the chief factor, other elements such as better conditions of nutrition, etc., probably enter in as less important factors.

These researches were carried on in the biological laboratories of the University of Wisconsin.

Baltimore, Md.

Noteworthy anatomical and physiological researches.

Apical areas in seed plants.

The copious researches of MM. Van Tieghem and Douliot[1] on the origin of endogenous members in the vascular plants, published in the *Annales des Sciences Naturelles Botanique* during 1888, will be remembered by all students of contemporary botanical literature. The conclusions arrived at regarding the apical cells of monocotyledons and the single apical cell of the Archispermæ (gymosperms) are well known, having already found their way into at least one of the more prominent text-books. It is by no means universally admitted, however, that the proof of apical cells in these groups of plants is decisive. The older literature on the subject was given in résumé by Dingler[2] in 1882, but since that time the important works of Karsten,[3] DeKlercher,[4] Groom,[5] Korschelt,[6] and others have appeared, supplementing the classic researches of Strasburger, Hanstein, Hofmeister, and the rest. In the *Ann. des Sciences Nat. Botanique*, 1890, Douliot[7] reviews the later works and, adding some investigations of his own, maintains the positions advanced in 1888 in his paper in conjunction with Van Tieghem. In brief, his conclusions are as follows:

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[1] Recherches comparatives sur l'origines des membres endogènes, Ann. Sci. Nat. Botan., VII. VIII. I. (1888.)

[2] Ueber das Scheitelwachsthum des Gymnospermen-Stammes, München, 1882.

[3] Ueber die Anlage seitlicher Organe bei den Pflanzen, Leipzig, 1886.

[4] Sur l'anatomie et le développement du Ceratophyllum, Bihang, k. Sv. Vet. Acad. Hand. IX, Stockholm, 1885.

[5] Ueber den Vegetationspunkt der Phanerogamen, Ber. der deutsch. bot. Gesell. 1885.

[6] Zur Frage über das Scheitelwachsthums bei den Phanerogamen, Pringsh. Jahrb. wiss. Bot. 1884.

[7] Sur la croissance terminale de la tige, Ann. Sci. Nat. Botan. VII, XI. 283.

(1). In the twenty genera of gymnosperms which have been studied the uniform presence of a single apical cell at the summit of the growing stem has been demonstrated. This cell, as in the lower vascular Archegoniata, is sometimes pyramidal, sometimes prismatic, but always solitary. Here is the diagnostic anatomical character of the Gymnospermæ. They are, by it alone, sharply discriminated from the rest of the seed-plant phylum.

(2). In the monocotyledons there are two categories to be distinguished; first where there are three initial cells at the apex of the stem from which all the others are derived, as in Phragmites, Tradescantia, Zea, Asparagus, Polygonatum, Canna and others; and second, where there are but two, as in the Naiadaceæ, Potamogetonaceæ, Juncaceæ, Alismaceæ and Hydrocharidaceæ. The latter case is the more frequent.

(3). In the great majority of the dicotyledons the stem is terminated by three apical or initial cells. In a small number, principally in the the apetalous division of the Archichlamydeæ, there are only two initials, and in this case one initial cell is common to the dermatogen and plerome layers of Hanstein, but in the other and more common case each embryonic layer has its own peculiar initial cell. In the Gamopetalæ (Metachlamydeæ) there are three initials, so far as the investigations have gone.

It is thus seen that, in addition to a clearly functional archegonium or egg-organ, the Archispermæ (Gymnospermæ) are distinguished from the Metaspermæ (Angiospermæ) by the presence of a single apical cell. Thus evidence seems to be accumulating in favor of the classification, long ago proposed, which would include the Coniferæ, Cycadeæ and Gnetaceæ with the Pteridophyta, Bryophyta and Characeæ (and possibly the Coleochaeteæ) under the Archegoniatæ—those plants with a functional egg-organ. The Metaspermæ are sharply distinguished by the abortion of the egg-organ while the Thallophyta are as clearly discriminated by the absence or rudimentary condition of the egg-organ. In addition to these characters the Metaspermæ are the only plants which develop their epidermis independently from a definite proto-epidermal meristem cell. This character seems to be an important one from a phylogenetic point of view and gives color to any plan which proposes to recognise the great affinity between the heterosporous Filicneæ and Lycopodineæ, re-

spectively, and the Cycadeæ and Coniferæ. In this connection one can not but deplore that in some quarters American botany has not yet freed itself from the altogether obsolete notion that the Coniferæ should be placed between the monocotyledons and the dicotyledons.—CONWAY MACMILLAN.

Effects of parasitism of Ustilago antherarum Fries.[1]

Ustilago antherarum is included by Saccardo[2] under *U. violacea* (Pers.) Fckl. and is well known as parasitic in the anthers and ovaries of Silene, Lychnis, Saponaria, Pinguicula, Stellaria and other allied plants. By the growth of the fungus, what has been termed by A. Giard "parasitic castration of the anthers" takes place. There is, however, a hypertrophic development of the anther and in the diclinous flowers of Lychnis, which have in common with other such flowers rudiments of the undeveloped sporangia—this hypertrophy suffices to give the flower a monoclinous appearance. Under the irritation of the parasite the rudimentary anthers in pistillate Lychnis flowers are stimulated to develop, but the tapetal and archesporial layers of the thecæ are supplanted by the fungus mycelium and subsequent growth of spores. For a considerable time the Ustilago plant develops by a kind of symbiosis with the cells of the host. This goes so far that the anther walls are, in normally pistillate Lychnis flowers, stimulated to form the typical layers by which the ordinary dehiscence is brought about. Thus the Ustilago spores are scattered from the hypertrophic anthers of Lychnis precisely as if they were normal pollen spores. A corresponding and attendant atrophy of the pistil will be observed in most cases, and it is the nutritive stream which properly should go toward the pistil, that is diverted toward the hypertrophic anthers. And furthermore the various accessory characters of the staminate flower are developed in proper order under this parasitic stimulation, so that the normally pistillate but apparently staminate flower presents the appearance of pollen-bearing to such an extent that it is doubtless visited by those insects which habitually transfer pollen from the staminate flower to the stigma of the pistillate. Now as the Ustilago spores are developed in lieu of pollen spores and make their

[1] Vuillemin: Sur les effets du parasitism de l'Ustilago antherarum, Comptes Rendus Hebd. CXIII. 662. (1891.)
[2] Sylloge Fungorum VII. 574.

appearance in a hypertrophic rudimentary anther which under their stimulation, forms the ordinary dehiscence lines, it happens that when the spores of the Ustilago are ripe, they are distributed by the same means and agencies which commonly distribute the Lychnis pollen. This is of clear advantage to the fungus for it is thus sown upon young buds as well as upon stigmatic areas. The whole series of phenomena is one which indicates in very interesting fashion how intimate and remarkable may be the relation between host and parasite.—CONWAY MACMILLAN.

The behavior of the pollen-tube of gymnosperms.

In a recent paper,[1] preliminary to a more complete research Belajeff publishes some suggestive observations regarding the divisions which take place in the pollen-tube of *Taxus baccata.*

It is well known that one or more cells are commonly cut off from the body of the pollen grain early in its development. Many have considered this cell or cells as representing a male prothallium, and Strasburger states that they have to do with the formation of the pollen tube, and after that have no further part to play. Belajeff, however, was led by his researches into the antheridia of the higher cryptogams and the pollen tubes of the angiosperms to think that it was not the large cell of the pollen grain of gymnosperms, but the small ones which have to do with fertilization. He therefore examined with great care the processes in Taxus baccata with the following result:

In this plant the contents of the pollen grain divides into two cells one large and one small. The larger one, *a*, produces the tube, the nucleus and other contents wandering to the apex. The smaller cell *b*, which remains behind, then divides into two by a partition transverse to the axis of the tube. The anterior of these two, *b'* then wanders toward the apex of the tube while the posterior *b,"* becomes disorganized. Its nucleus however also wanders toward the apex, usually passing the anterior cell. The apex of the pollen tube now increases in size considerably as does also the cell *b'*. The nucleus of this now divides into two, one spherical, and the other lenticular. When fertilization occurs the wall of the pollen tube and the very delicate wall of the cell *b'* disappears and the

[1] Berichte der deutschen bot. Gesellschaft IX. 280. (1891.)

spherical nucleus of *b'* fuses with the nucleus of the egg cell of the archegonium.

While it is hardly safe to generalize from such limited observations (for so far they have been confirmed only on Juniperus and that but partially) nevertheless the observations accord much better with what we should expect from analogy with lower and higher plants. If these observations are confirmed by more extended study the pollen tube must be looked upon as the prothallium, while the small cells constitute the antheridium. The one which travels to the apex of the tube must be the mother cell of an antherozoid, to which the spherical nucleus would correspond. Perhaps on account of the imperfect division of *b'* it would have to be considered as more primitive still, being the homologue of the cells from which the antherozoid mother-cells arise.—R.

BRIEFER ARTICLES.

Notes on pollination.— I. The sandy hills, old trees and fences on the north shore of Long Island are covered with *Ampelopsis quinquefolia* Michx. The numerous small, greenish-yellow flowers are quite conspicuous in contrast with their background of green leaves. On the morning of July 22d, there were twenty-two flowers open on one cyme, the pollen-covered stamens outspread, the erect stigma occupying the flower center. Numerous visitors — honey bees, humble-bees, hornets, Sphecidæ, other Hymenoptera small and large, and Diptera — were either sucking the nectar which is exposed in the base of the flower and accessible to the shortest tongues, or collecting or eating the pollen. Almost all of them touched both stamens and stigma before leaving a flower. Early in the afternoon of the same day stamens and petals had fallen from all of these flowers but the visitors continued their visits as industriously as ever — of course, now only sucking nectar.

On the morning of July 23d, no more flowers had opened, and there were none with stamens on this whole plant or on any of the plants near by. The number of visitors was diminished. Early in the afternoon many new flowers had opened on all the plants and insects abounded. July 24th, at 8 A. M., after a heavy rain, very few stamens and petals remained. At 11 A. M. there were many newly opened flowers. July 25th, at 2 P. M., no stamens.

The stigmas appear to remain receptive for some days and the older flowers which contain them alone are visited as often as the freshly opened ones. Self-pollination, which would be easily accomplished, is only possible in the few hours during which the stamens last and even then, owing to the great number of visitors, cross-pollination seems much more probable in pleasant weather.

II. The species of *Trillium* have, so far as I know, been studied with reference to their pollination only by Loew, whose meager notes on imported plants are recorded in Pringsheim's Jahrbücher, vol. XXIII, p. 238.

Four species are grown in the Botanical Garden at South Hadley, Mass., as nearly as possible under natural conditions.

1. The very inconspicuous, dull reddish-brown flowers of *T. sessile* L. are erect "in the bosom of the leaves." The stamens closely surround the stigma. Self-pollination seems inevitable. There is no honey. No visitors were seen though the flowers were watched at intervals each day during their period of flowering. Loew reports one pollen-eating beetle.

2. *Trillium erectum* L. The rather large, brown-red flowers are abundant and rather conspicuous in the Massachusetts woods in early spring. Their strong, disagreeable odor may perhaps attract carrion-loving flies or beetles. Unfortunately I could not watch the flowers in the woods and there were only a few in the garden. Stigmas and anthers stand at nearly the same level, freely exposed in the flower-center by the recurving of sepals and petals. There is no honey and for many days no visitors appeared. Finally four Coleoptera came in one day, apparently to eat the stamens—certainly of little avail in cross-pollination and probably too late to be of use in any case. Spontaneous self-pollination seems to be the rule here too.

3. One morning, some time after the blossoms had all disappeared, a humble-bee flying by me vanished under the leaves of the blood-root bed and continued his buzzing there so contentedly that it was evident treasure had been found. Following him, and pushing aside the large leaves of the blood-root, I found, concealed under these leaves and their own too, the nodding flowers of *Trillium cernuum* L., well hidden from human view but recognized from afar by the keen senses of their lover. He was busily at work sucking nectar which was afterwards seen in small drops at the ovary base, between the ovary and the bases of the filaments opposite the inner perianth leaves. This species is slightly proterandrous, the stamens dehiscing before the petals are outspread and while the stigmas are still close together. After the nodding flower has fully opened self-pollination is easy, the recurving stigmas being just below the pollen-covered anthers.

4. *T. grandiflorum* Salisb. In the first stage, the mouth of the flower is closed by the anthers. Later, the petals expand further, the stamens separate above and the stigmas appear between them, in the flower-center. A little nectar secreted by the "septal glands" lies between the ovary and filaments as in the preceding species. Hive bees occasionally collect the pollen. The stigmas recurving to meet the stamens may be self-pollinated in the absence of visitors.

III. *Oakesia sessilifolia* Wats., *Uvularia perfoliata* L., *Clintonia borealis* Raf., are visited abundantly by humble bees for the nectar contained in the hollowed bases of the perianth-leaves.

IV. While watching the pollination of Asters and Solidagos this fall, I was surprised to find large numbers of humble-bees, honey-bees, wasps, and other large and small Hymenoptera, flies—notably Syrphidæ, beetles and four species of Lepidoptera, visiting *Solidago squarrosa* whose flowers were all withered, to suck the nectar secreted by the involucral bracts. This is another of the cases of the occurrence of the extra floral nectar whose use, if any, to this plant has yet to be discovered.

An article in the *Biologisches Centralblatt* (vol. VIII, p. 577) may shed some light on the use of these extra-floral nectaries. It is in substance this:

Von Wettstein has observed the accumulation of nectar on the involucral scales of *Jurinea mollis*, *Serratula lycopifolia*, *S. centauroides*, *Centaurea alpina*, &c.

In *Jurinea* the secretion begins when the head has attained one-fourth of its full development: it ceases when the first flowers unfold. It begins each day directly after sunrise, increases until about 8 o'clock and then commonly diminishes until evening. Even before sun rise one may find ants sitting motionless upon the buds; as soon as the nectar-secretion begins they seek most eagerly for the places on the scales at which it appears. Of 250 unopened heads, only ten were without ants. The greatest number on one head was twelve, the average three or four. Not seldom they creep over the flowers so that the purpose seems not to be to exclude them from these. Experiment establishes the truth of the theory that the ants, here as in so many other cases, are the protectors of the plants—the pigmies, the body-guard of the giants, as it were.

Fifty buds were protected against ants by winding their stems with wool soaked in camphor-solution and oil. Fifty others were left untouched. After four days all of the heads were examined. Forty-seven of the last lot remained; forty-five of them (90 per cent.) had blossomed normally; beetles had eaten the involucral scales of two;

one had been broken by the wind. Forty-six of the protected heads remained. Twenty-seven (only 54 per cent.) had blossomed normally; seventeen were more or less injured by animals. Ants had gained access to two.

Experiments with *Serratula lycopifolia* Vill., gave similar results, so that the usefulness of the ants in both of these cases can hardly be disputed. But both plants are natives of the tropics where ants are most abundant and most wonderfully developed.

There were few ants upon the involucres of *Solidago squarrosa*. Perhaps this very fact accounts for the large number of beetles. But the beetles as well as the numerous other visitors all seemed to suck the nectar without doing injury to the head, and moreover they were observed after all or very nearly all of the flowers were gone, and their visits continued until the coming of cold weather, that is for about two weeks, if my memory is good.

Ludwig says: "In Jurinea the involucral scales are reflexed during anthesis forming a protection to the flowers, while the scales of Serratula are appressed and accordingly, in Serratula the secretion of nectar continues after blossoming." Solidago differs from both, for its involucral scales are reflexed, and the secretion is of long continuance. The plants were grown under unnatural conditions, on an exposed hill at the edge of the Horticultural Garden here at Ithaca. It will be necessary to observe them in their own haunts another year to ascertain surely whether ants are their guests and the champions against their foes.—ALICE CARTER, *Ithaca, N. Y.*

EDITORIAL.

A NEW FEATURE for American expositions has been inaugurated by the World's Fair commissioners. It is proposed to hold a series of congresses in connection with the Fair, to which those interested in the various departments of knowledge are to be invited. These are to be conducted in the same generous spirit which characterizes the other projects of the exposition. The preliminary circulars have been issued, and some of the special congresses are already quite well organized.

Plans for the Botanical Congress are now under consideration. What these plans shall be depends largely upon the botanists of the country. It is much to be desired that a full and hearty expression of opinion be made public through the botanical and other journals, to

serve as a guide for the committee in charge. As it is necessary to push the arrangements as rapidly as possible, those who have words of suggestion or encouragement to offer should not delay to make them known.

The plan, so far as it has been outlined at present, is to invite the botanists of the world to meet at Chicago, sometime during August, 1893, to discuss such matters of interest as may be arranged for beforehand or be brought up at the time, and to enjoy the benefits of personal acquaintance. During the meeting a few stated lectures will be given by distinguished botanists, designed more especially for the general public. Excursions and other means of promoting good fellowship and a profitable time are among the possibilities.

It is hoped to secure for the gathering a truly international character, which will make it not only a notable and pleasant occasion, but give its deliberations a weight and sanction of authority that will do much toward settling disputed questions and advancing the science.

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IN THE September number of *Grevillea* the editor makes the most startling comments on the availability of German mycological works. He says, referring to Brefeld's *Untersuchungen aus dem gesammt Gebiete der Mykologie,* "Mycologists are very limited in number in these islands, and some of these are unable to purchase indiscriminately . . . whilst the number capable of perusing German with ease is considerably less. All those capable of reading and appreciating Dr. Brefeld's works for instance, could be counted on the fingers of one hand!" That, if true, is a lamentable condition. But we hope the statement is too strong.

CURRENT LITERATURE.

Minor Notices.

THE ANNUAL report of 1890 of the state botanist of New York,[1] Chas. H. Peck, contains a list of the plants added to the herbarium during the year (261 species); among which are thirty-six new species of fungi. These are described, and figured on the four plates. There is also a revision of the genus *Tricholoma* which is represented in the

[1] PECK, CHARLES H.—Annual report of the state botanist of the state of New York, made to the regents of the University. From the 44th report of the N. Y. state museum of Natural History. 8vo. pp. 75. pl. 4. Albany: Lyon, state printer, 1891.

state by forty-eight species. The revision is accompanied by full descriptions of these species, with synoptical tables of each of the different groups. The report closes with a list of the plates in a MS. volume regarding the fleshy fungi of Maryland prepared in the course of several years by Miss Mary E. Banning of Baltimore. Miss Banning has made water-color drawings (175 sheets 12×15 inches) of 151 species, accompanied by MS. descriptions and notes, together with a full index. This volume she has presented to the State Museum — a most generous and valuable gift.

VERY FEW researches on the bacteria of the deep sea have been made; indeed the studies of Mr. H. L. Russell, a graduate and sometime Fellow of the University of Wisconsin, which he prosecuted at the zoölogical station at Naples, are almost the first. Through the kindness of the director, Dr. Dohrn, every convenience was afforded him for obtaining samples of water and slime at every available depth in the Gulf of Naples and for investigating the forms so obtained. A large number of soundings were made, up to 1100 meters (3600 ft.). While the observations were not sufficiently numerous to constitute a complete investigation of the subject, the conclusions reached are interesting. Mr. Russell found that the number of micro-organisms present in the sea water appeared rather smaller than those in an equal volume of fresh water. (Upon the latter the author made prolonged study while at the University of Wisconsin.) There do not appear to be any zones of distribution of the bacteria in the water, but the superficial and deepest parts have about the same number. In the slime the number is always vastly greater than in the water above; and their proportion, except perhaps in the littoral zone, is not due to contributions from land but from the growth and multiplication of endemic individuals. Although there are no zones of distribution in the water, in the slime there is a gradual diminution from the maximum near the surface to a depth of 200 m., but from that depth on to 1100 m. (the greatest depth investigated) there is no diminution. The minimum was therefore not reached.

Mr. Russell has brought back with him a large number of cultures of the forms obtained from the deep sea which he intends investigating qualitatively.

DR. C. E. BESSEY publishes as a bulletin of the agricultural experiment station, a list of the native trees and shrubs of Nebraska. The

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[1] RUSSELL, H. L.—Untersuchungen über in Golf von Neapel lebende Bacterien. Separat-Abdruck aus der Zeitschrift für Hygeine und Infectionskrankheiten, Band XI. 1891. 8vo. pp. 165—207. pl. XII. and XIII. 1891.

list includes 125 species, about equally divided between the two. A discussion of the distribution of the woody plants of the state at the close is interesting. Dr. Bessey thinks that this distribution shows that the woody plants have nearly all come up the Missouri bottoms and spread west and north-west. Those found only in the western part have undoubtedly come from the Rocky Mountains and have spread eastward to their present limits.

The nomenclature of the list shows a wide departure from that of the Manuals. Justifiable as many of these departures are, they seem out of place in such a publication as the present, because they certainly interfere with its usefulness for those not specialists.[1]

If collectors are not properly informed as to how to collect plants it will not be for want of instructions. Two months ago we noticed Prof. Penhallow's booklet; now we have before us a pamphlet issued by the National Museum and prepared by Mr. F. H. Knowlton.[2] It contains directions for collecting all sorts of plants, as well as for caring for them after they are collected. In its preparation the author has drawn freely on Bailey's Collector's Handbook and the herbarium number of this journal (June, 1886, for which there was such a demand that the extra edition was soon exhausted). In many respects the present directions are better than their predecessors; it extends their range by giving directions for the collection of fossil plants. Certainly now if one puts together the instructions to be found in every text book and in almost every flora, those of Bailey, Penhallow and Knowlton, he will have all the knowledge that writing can give him of how to preserve plants. *Jam satis!*

OPEN LETTERS.

A section of botany in the American Association.

The thought of having a section for the botanists in the A. A. A. S. should be very inspiring to all who have at heart the thorough study of plant life in America. All admit that Section F is now crowded with members and papers, and doubtless many are deterred from taking part in the sessions from lack of opportunity. At the last

[1] Bessey, C. E.—Preliminary report on the native trees and shrubs of Nebraska. Bulletin 18 of the Ag. Exp. Sta. of Neb., vol. iv. art. iv. pp. 171–202.

[2] Knowlton, F. H.—Directions for collecting recent and fossil plants. Part B of Bulletin of U. S. Nat. Mus. no. 39. 8vo. pp. 46. figs. 10. Washington: Gov. Printing Office. 1891.

meeting numerous papers were passed without comment or discussion that the programme might be carried out.

The work of the section has naturally divided itself into two groups, namely, that pertaining to animal life, and to botany. In order to gain more time and draw together more closely those who are interested in particular branches, clubs have been formed. Thus the entomogical and botanical clubs have arisen and grown into features of the week of as much importance as the section and more perhaps to the younger members. These clubs should, and doubtless will be continued. In the section itself for years there has been an attempt on the part of the programme committee to group the subjects so that zoölogists and entomologists have had a half day assigned them, alternately with the botanists. This has virtually broken up the continuous attendance of members upon the sectional meetings and excursions or other events are indulged in by the party not upon the programme. Perhaps to our shame, this has been particularly true of the botanists who have sometimes left the zoölogists with a depleted but more homogeneous and attentive audience. Also within the past few years the plan of having time assigned for a series of connected papers upon one or more of the branches of science coming under the present scope of the section has still further differentiated the work. As Section F now stands its sessions are largely an alternation of groups of subjects with an audience that shifts with the programme.

A notice of an amendment to divide Section F is therefore well founded; the division is very natural and one that, in fact, has already been made, so far as arranging the programme by grouping the subjects and by the work of the clubs will permit it. In short, it has gone as far as it can save by a division of the section itself.

The contemplated division will bring many gains without corresponding losses. Time will then be offered for thorough sectional work upon the two large and growing fields of biological science, instead of the rapid reading of papers as at present, followed by little or no discussion before a half interested audience.

With a Section of Botany, for example, officers can be selected who will be interested in all subjects presented, a condition that does not always obtain under the present arrangement, to say nothing about the difficulty that may now arise as to the proper apportionment of the official plums among the aspirants for honors.

If we believe in the principle of division of labor and specialization, in short in the theory of evolution in its broad and best sense, we cannot but feel that the proposed step is in the direction of advance, and realize that the last few meetings of Section F indicate clearly that the time to take the step forward is at hand.

The best way to make the importance of a division still more emphatic is for every student of the biological sciences to come, if possible to the Rochester meeting with a large number of full papers, and strive to have as many as possible read and discussed in Section F, the balance of shorter ones to be considered as best they may at the clubs. As a section of Botany is asked for, let the botanists in particular show by their works, their faith in the reasonableness of the demand.— BYRON D. HALSTED, *Rutgers College.*

The Baltimore oriole mutilating flowers.

The interesting note of J. Schneck in regard to the oriole piercing the flowers of the trumpet-vine for the nectar reminds me of a note which I sent the *American Naturalist*, and printed in 1869, on p. 380. In that case the Missouri currant (*Ribes aureum*) was the plant. The fact of their piercing large numbers of flowers for at least two seasons in the village of Union Springs, Cayuga county, was well established. Honey bees gleaned freely of the honey through these holes, as the corolla is too long for them to reach it through the tube.— W. J. BEAL, *Agricultural College, Michigan.*

Misconceptions of botanical homologies.

I had occasion in the June number of the GAZETTE, last year, to call attention, on pp. 178, 179, to the vicious confusion in the terminology of the spermaphytic flower. Two melancholy examples of this confusion have just come to my notice and I cannot forbear referring to them. One is on pp. 162, 163 of Warming's *Haandbog i den systematiske Botanik* (German translation), where under the bold headline *Die ungeschlechtliche Generation der Kormophyten* occurs considerable talk about "eingeschlechtig," "zweigeschlechtig" and "hermaphrodite" flowers, thus affording an exquisite illustration of how easy it is to classify black, blue and green under the generic head of pale yellow.

The other example is sadder, for it is the cause of a serious blunder. It is in Geddes and Thompson's "Significance of Sex," a very suggestive and admirable work, after reading which one can not but regret that it apparently did not occur to the authors to give particular attention to botany as one of the biological sciences. But this is an ordinary oversight. On p. 48, where the discussion of nutrition as influencing sex is going on, we have a couple of tolerable pictures of the diclinous, asexual, pollenar and ovular plants of *Lychnis diurna* figuring as the "male and female flowers;" and, basing their remarks upon such a failure to comprehend plant homologies, the authors observe that "the botanical evidence, though by no means very strong, certainly corroborates the general result that good nourishment produces a preponderance of females." It is just here that Geddes and Thompson, misled by the false terminology which botanists, to their discredit, still suffer to continue, lose the opportunity of making a strong point along their line of research.

Let us see what the condition really is in plants of the type of *Lychnis*. The pollen grain or microspore produces a one or two-celled male plant — the pollen-tube: the megaspore or embryo-sac produces a seven-celled female plant. What was the origin of the two sizes of spores? In short this: spore-mother-cells in certain sporangia divided internally into four spore-cells, each of which developed to maturity and was a pollen-spore. In other sporangia the spore-mother-cell formed four nuclei and the potentially *four*-spored contents produced only *one* spore — the embryo-sac — *because one of the cell-nuclei reabsorbed the others, and one cell united to itself the three sister cells.* Where could there be found a more instructive example of high spore-nutrition tending to develop a female plant? It is superb. One might challenge the zoölogist to bring forward any evidence

clearer than this. In fact it is in the plant world that we must look for much of our testimony along the more diffcult lines of biological science. And it is the duty of botanists to clear up the confusion of their terminology, especially along those lines which are subject to so great popular misapprehension. It should not be possible, even for the casual reader of botany, to encounter such contradiction and error as clusters about the spermaphytic plants, imbedded in a misleading terminology.— CONWAY MACMILLAN, *University of Minnesota, Minneapolis.*

NOTES AND NEWS.

THE VENERABLE curator of the botanical museum at Berlin, Friedrich Karl Dietrich, is dead at the age of 85.

DURING THE year 1890 42,646 specimens were added to the Herbarium of the British Museum, according to the report just published.

MR. A. S. HITCHCOCK, of the Missouri Botanical Garden, has been appointed Professor of Botany in the Agricultural College of Kansas at Manhattan.

MR. P. H. ROLFS, recently connected with the Iowa Agricultural College, at Ames, has been appointed botanist and entomologist of the Florida Agricultural Experiment Station at Lake City, Fla.

MR. WILLIAM WEST has a paper in the December number of the *Journal of Botany* on the freshwater Algae of Maine, in which three new species and several new varieties are described. There are also notes on other species of the collection.

DR. FR. ORTLOFF of Coburg (Thuringia) Germany, has just issued a series of photographic reproductions of the stem-leaves of Sphagnum which are of so much diagnostic importance in the discrimination of the polymorphic species of this genus. The series contains 63 plates.

PROF. L. H. BAILEY has been appointed special agent of the United States Weather Bureau to make a report upon phenology, and desires reference to all records upon the relation of climate to the times of blooming, fruiting, leafing, etc., of plants. He may be addressed at Ithaca, N. Y.

PROF. R. E. CALL has given an account of the silicified woods of E. Arkansas in the *American Journal of Science* (Nov. 1891), in which he concludes that they are all Tertiary (Eocene), are silicified lignite, and are as yet of no taxonomic value in determining relative ages in the Tertiary series.

THE MOSS herbarium of the late Dr. S. O. Lindberg has been acquired by the University of Helsingfors. Exclusive of duplicates and of numerous exsiccati the collection contains 5,046 species represented

by 47,858 specimens. It is especially rich in northern Hepaticæ, and is remarkable for the completeness, abundance and critical elaboration of the material.

PROF. W. W. BAILEY writes: "One of my students called my attention the other day to a *Linaria* raceme in which the flowers were all spurless. Peloria is not infrequent this autumn." And again: "As my colleague, Mr. Bennett, was drying some capsules of *Ceanothus* in the sun. for the purpose of securing the seeds, he noticed, and showed me, that these parts exploded with much violence, ejecting the seeds."

A FOUR PAGE supplement to the "Analytic Keys to the genera and species of North American mosses" has been prepared and issued as separates from the 8th volume of the Transactions of the Wisconsin Academy. It contains additions and corrections and may be obtained of the author (C. R. Barnes, 712 Langdon St., Madison, Wis.) *gratis*, by sending a request accompanied by a 2-cent stamp. It will be of no value except to those who have a copy of the Keys.

THE SERIES of *Hepaticæ Americanæ exsiccatæ* has been issued by L. M. Underwood and O. F. Cook, in sets of two decades annually since 1887. Many rare and previously undistributed species have been sent out, and others are to follow, including specimens from British Columbia, Florida, Cuba and Mexico. Decades XI and XII are now ready for distribution. Preceding issues are all exhausted with the exception of decades IX and X, of which a few sets are still on hand. Correspondents should now address Dr. Underwood at Greencastle, Ind.

IN VIEW OF a contemplated special investigation of the genus Astragalus (including Phaca, Diplotheca, Homalobus, and Podolotus), Mr. E. P. Sheldon, Assistant in Botany at the University of Minnesota in Minneapolis, desires specimens of this genus from all parts of the world. In exchange he offers either fungi or flowering plants from the valley of the Minnesota river, which derives a peculiar interest from its position as the central drainage system of the continent of North America. Plants may be sent to him in care of the university, and will be promptly acknowledged.

THE HERBARIUM of Indiana University was established upon the election last April, of Professor John M. Coulter, as President. In addition to private material already in the possession of Professor Coulter, a liberal appropriation for the purchase of plants was made. All the well-known collectors of phanerogams and pteridophytes were asked to furnish as complete sets of their collections as possible, and these purchases now amount to over 15,000 species of North American plants. A very valuable library of reference books has also been secured. It is expected that the collection of books and plants will increase as rapidly as material for purchase or exchange becomes accessible. Mr. Henry E. Seaton has been appointed curator.

A NEW JOURNAL of forestry, *Forstlich-naturwissenchaftliche Zeitschrift*, is to be begun with the year. It is to be the organ for the Munich laboratories of forest botany, zoology, chemistry and meteorology, under the editorial management of Privat-docent Dr. Carl von Tubeuf of the University of Munich. Of course it has the support

and contributions of Dr. R. Hartig who is to continue in this journal the "Untersuchungen aus dem forstbotanischen Institut" he ceased to publish in 1883. Drs. Ebermayer, Pauly and Baumann of Munich are to aid, and the journal has the promise of coöperation from many others who are learned in forestry. Among these we notice but one from this country, Mr. B. E. Fernow, chief of the division of forestry of the Agricultural Department.

Dr. Paul Knuth seeks to explain why many flowers, without apparently very attractive coloration are so readily found by insects. *Sicyos angulata*, for example, was surrounded by swarms of insects, while at the same time other plants in the botanic garden at Kiel were neglected. The ethereal oil secreted by the glands of the flowers, stem and leaves, which affect the senses of man so slightly, may be partly the cause of the attractiveness of this plant to its insect visitors. But he finds also that the greenish white flowers are probably much more striking to insect eyes than to our own, on account of the ultra-violet rays which lie beyond the range of our vision. That such rays are reflected by these flowers he showed by their effectiveness upon photographic plates with short exposures. They are photographically as active as white flowers, while the intensity of light reflected (photometric activity) is only one-third that of white flowers. We have here apparently an analogy with those sounds which can be heard by insects, but which are beyond the range of the human ear.

Mr. John B. Leiberg writes from northern Idaho: "My list of mosses from this region now foots up 304 species and varieties. Many of these are as yet undetermined. Some have only turned up as fragments amongst other mosses. . . . The magnitude of western bryology is utterly unappreciated by bryologists of this country unless they have been here in person and seen it with their own eyes. Most of my observations have been limited to the western slope of the Bitterroot mountains. There are 250 miles of this range extending north and south, and the width of the western slope varies from 30 to 120 miles. There are millions of canyons and ravines in this tract of country. Of all the thousands I have seen into I never saw two where exactly the same climatic conditions prevailed. It is a fact easily proved that changes on climatic conditions mean changes in both the vegetative and structural aspect of mosses more quickly than in any other group of plants. . . . It is an impossibility for collectors to obtain all the various aspects of any species for generations to come, so our knowledge of the western mosses will come slowly and painfully, for collecting mosses among these mountains is no holiday excursion."

Dr. Fr. Krasser recommends the following methods for preparation of permanent mounts of aleurone grains to show the ground substance, crystalloid and globoid differentially stained.

I. Picro-eosin method. Fix the section with picric acid dissolved in absolute alcohol; remove the excess by washing with absolute or a high grade alcohol; stain with eosin dissolved in absolute alcohol; partially decolorize with absolute alcohol; clear with clove oil; mount in Canada balsam dissolved in chloroform. The course of the stain-

ing, which is completed in a few minutes, should be watched under the microscope, as should also the toning down. The most successful preparations show the ground-substance dark red, the crystalloid yellow with sharp contours, and the globoid nearly colorless to reddish.

II. Picro-nigrosin method. Place the section in alcoholic-picro-nigrosin (a saturated solution of picric acid in absolute alcohol+nigrosin approximately to saturation) in which it is allowed to remain until the ground-substance of the aleurone grain shows a blue coloration. This is to be determined by observations at intervals with the microscope, the specimens being put into absolute alcohol temporarily. Wash with absolute alcohol; clear on the slide with clove oil; mount in Canada balsam, removing the clove oil with filter paper. The most successful preparations show the ground substance blue, the globoid colorless, and the crystalloid yellowish green and sharply limited.

THE difficulty of keeping Irish potatoes in edible condition in late spring is well known to housekeepers, farmers, and merchants. Professor Schribaux of the National College of Agriculture of France has recently devised a very simple, cheap, and successful method by which he has been able to preserve potatoes in edible condition for over a year and a half. This process has been adopted by the French government for preserving potatoes for the army. The French Minister of Agriculture publishes the details of the process in the official *Bulletin du Ministère de l'Agriculture* for March, 1891. The following is a translation of the essential part of the scheme. The method of preservation consists in plunging the tubers, before storing them away, for ten hours into a two per cent. solution of commercial sulphuric acid in water, two parts of acid to 100 parts of water. The acid penetrates the eyes to the depth of about one-fortieth of an inch, which serves to destroy their sprouting power; it does not have any appreciable effect upon the skin of the potatoes. After remaining in the liquid ten hours the tubers must be thoroughly dried before storing away. The same liquid may be used any number of times with equally good results. A barrel or tank of any kind will do for the treatment. The acid is so dilute it does not affect the wood. Chemical analysis shows that potatoes treated by this process are as nutritious and healthful after eighteen months as when freshly dug; but they are of course worthless for planting. Attention is called to this method by Gerald McCarthy, N. C. Experiment Station, Raleigh.—*Science*, Nov. 13.

IN THE *Revue Bryologique* (n. 6, 1891) appears a synoptic table of the species of the genus *Fontinalis* recognized by M. Jules Cardot in his recent revision of the family Fontinaleæ. which he hopes to publish early this year. The North American species are as follows according to M. Cardot:

§ I. Tropidophyllæ.

F. antipyretica L. (N. Am.)
var. gigantea Sull. (N. Am.)
var. Californica Lesq.—(Calif.)
var. Oregonensis R. & C.—(Oregon.)
var. rigens R. & C.—(Vancouver: Wash.)
var. ambigua Card.—(Oregon.)

*F. Kindbergii R. & C.—(Vancouver: Oregon: Idaho.)
*F. Neo-Mexicana S. & L.—(Rocky Mts.: N. M.: Idaho: Calif.: Wash.: Vancouver.)
*F. Columbica Card.—(Br. Columbia.)
F. chrysophylla Card.—(Utah.)

§ II. **Heterophyllæ.**

F. Howellii R. & C.—(Oregon.)
F. biformis Sull.—(Ohio: Wisc.)
F. disticha Hook. & Wils.—(La., Ala.)
F. Renauldi Card.=*F.Sullivantii* Aust. non Lindb.; *F. Lescurii*, var. *ramosior* Sull.?—(New Jersey.)

§ III. **Lepidophyllæ.**

[F. squamosa L.]
*F. Delamarei R. & C.—(Miquelon.)
*F. Dalecarlica B. & S.—(Canada: Eastern States.)
F. Novæ-Angliæ Sull.—(Eastern States.)
*F. Cardoti Ren.—(Virginia.)
F. involuta R. & C.=*F.squamosa* Drumm. Musci-Am. II.n.152.—(La.)

§ IV. **Malacophyllæ.**

F. hypnoides Hartm.—(N. Am.)
*F. nitida Lindb. & Arn.—(Br. Columbia.)
*F. tenella Card.—Idaho.)
F. Duriæi Sch.—(California.)
F. Lescurii Sull.—(excl. var.)—(Canada, U. S.)
F. flaccida R. & C.—(La.)
F. Sullivantii Lindb.=*F. Lescurii*, var. *gracilescens* Sull.—(U. S.)

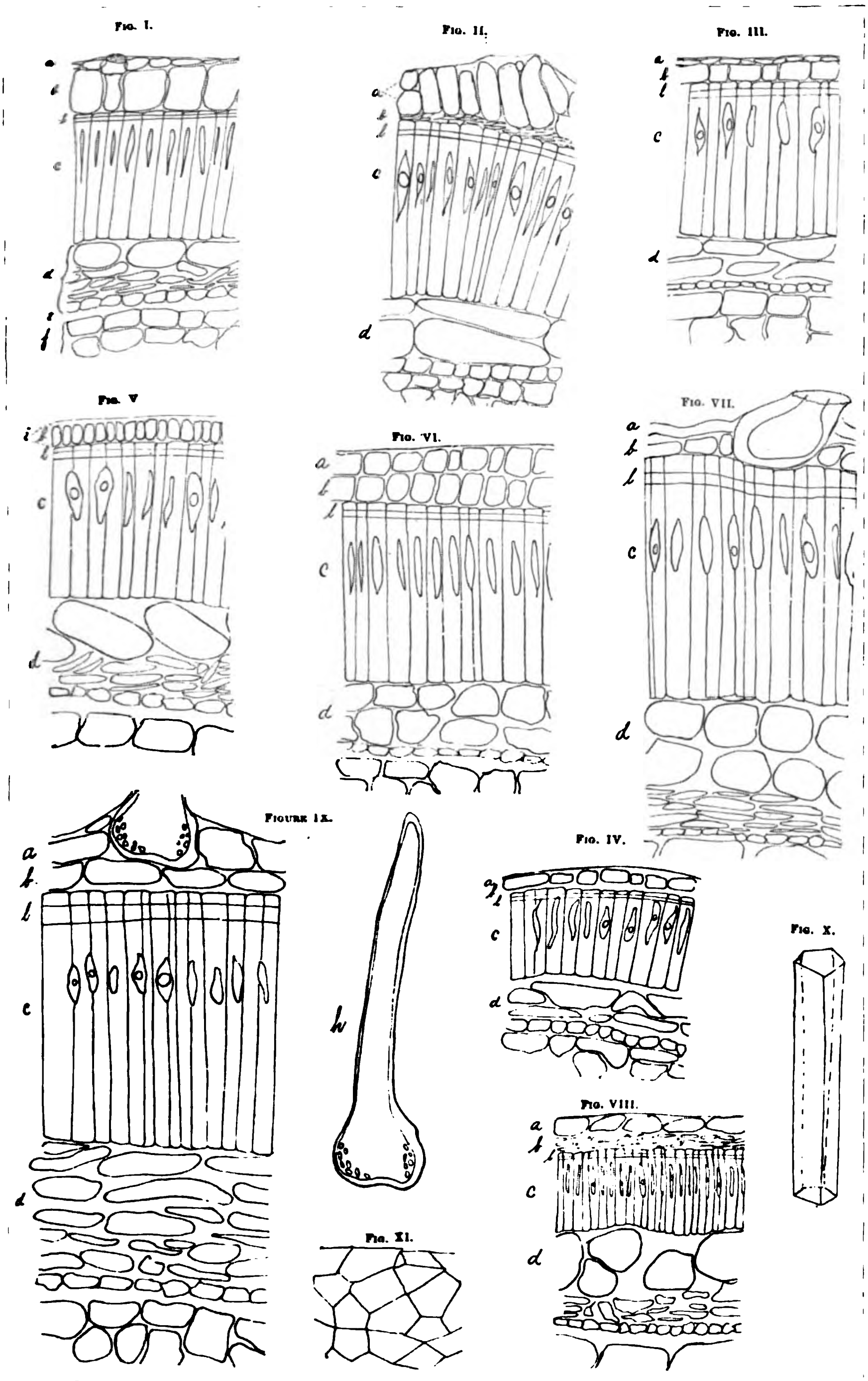
§ V. **Stenophyllæ.**

F. dichelymoides Lindb.—(Minn.)

§ VI. **Solenophyllæ.**

F. filiformis S. & L.—(Ky.)
F. Langloisii Card.—(La.)
F. maritima Müll. and *F. mollis* Müll. (Washington) are both unknown to M. Cardot. North America has 24 species and subspecies out of the 52 known.

*Subspecies.



ROLFS on SEED COATS.

BOTANICAL GAZETTE

FEBRUARY, 1892.

The seed coats of Malvaceæ.*

P. H. ROLFS.

(WITH PLATE III.)

Much attention has been given to the rich field of development and structure of seed coats. Most of the work has been done by European investigators. American botanists are rapidly taking up the work, and are studying not only the seed coats but the entire anatomical plant structure.

Of the investigators who have given the matter of seed coats attention, Gaertner,[1] Bischoff,[2] Schleiden and Vogel,[3] Harz,[4] Nobbe,[5] Sempolowski[6] and Lohde[7] may be mentioned. H. Godfrin,[8] who has examined the seed coats of thirty-four orders, finds that while the structure of the seed coats is useful in some directions, it is of no taxonomic value.[9] Bachmann,[10] in his paper on the development and structure of seed coats of Scrophulariaceæ, says that the microscopic characters of seed coats are of little value from a systematic standpoint.

In the order of presenting the different genera and species of this paper Gray's Manual has been followed. In all twenty-two genera and thirty-four species were studied. The gen-

*A thesis in Department of Botany, Iowa Agricultural College.

[1] GAERTNER: De Fructibus et Seminibus Plantarum, 1791.

[2] BISCHOFF: Handbuch der bot. Terminologie und Systemkunde, 1883.

[3] SCHLEIDEN and VOGEL: Ueber das Albumen insbesondere der Leguminoseen.

[4] HARZ: Landwirthschaftliche Samenkunde, Berlin, 1885.

[5] NOBBE: Handbuch der Samenkunde, Berlin, 1876.

[6] SEMPOLOWSKI: Ueber den Bau der Schalen landwirthschaftlich wichtiger Samen, 1874.

[7] LOHDE: Ueber die Entwickelungsgeschichte und der Bau einiger Samenschalen. Inaugural dissertation, Naumburg, 1874. p. 34.

[8] GODFRIN: Etude histologique sur les téguments seminaux des angiospermes. Nancy, 1880. pp. 112, 5 plates.

[9] L. H. PAMMEL: On seed coats of the genus Euphorbia. Proc. Am. Assoc. Adv. Sc. vol. XXXIX, 1890. p. 328.

[10] BACHMANN: Die Entwickelungsgeschichte und der Bau der Samenschalen der Scrophularineen. Halle, 1880. pp. 179, 4 plates.

eral structure of this order is very characteristic. There are minor differences only in the different species of the same genus and non-essential variations in the different genera.

The seeds of Malvaceæ are anatropous. The seed coat is made up of two integuments. The ovule is made up largely of parenchymatous tissue which in the early stages contains a great deal of starch. Upon the thickening of the endosperm cells this starch disappears.

A cross section of a recently fertilized ovule of *Malope trifida* Cav. discloses that but a slight differentiation in the two integuments has taken place; they are made up of prismatic cells, which in the outer layer are rectangular, while in the inner they are more nearly isodiametric. The difference is not alone in form; the outer integument is distinctly clearer than the inner, which is rich in protoplasm. This indicates that we are to have a more marked change in the inner than in the outer integument. In the course of development the cells of the outer integument change but slightly, simply increasing in size. The small starch grains contained in it disappear with the thickening of the walls of the cell. From the great radial growth of the first layer of cells in the inner integument and the thickening of the outer layer in the outer integument, the second layer of the outer integument is compressed until the upper and lower cell-walls are nearly or quite contiguous.

More decided changes take place in the inner integument. The second cell layer takes on a rounded form while the third layer of cells has been divided parallel to the endosperm. The second layer of cells increases rapidly in size compressing the fourth layer. During this time the first layer has lengthened out radially until the length of a cell is nearly three times its width. This layer is known as the palisade layer, which is so characteristic in this order. The palisade cells contain starch in the early stages. During the thickening of the walls the amount of starch diminishes. When the cell-walls have reached their thickness the starch has disappeared.

In a mature palisade cell, a cell cavity may be seen about one-third the distance from the outer end. These cavities often contain a spherical mass resembling a nucleus, which dissolves readily on the application of Schulze's medium. Between the cell cavity and the outer end of the palisade cell appears the light line which is present in a number of orders.

It appears as a continuous pellucid band (fig. 1 *l.*) across the outer end of the palisade cells. In the Leguminosæ this was noticed, at least as early as 1838, by Schleiden and Vogel.[11] The nature of this light line has been studied by a number of investigators. Quite different views have been taken in regard to it.[12]

Russow,[13] after investigation, comes to the conclusion that the cell-wall is more compact and contains less water at this place. Sempolowski[14] is of the opinion that it may be due to a differentiation in the molecular structure of the cell-walls. Lohde,[15] who studied carefully the development and structure of the seed coats of some Convolvulaceæ and Malvaceæ thinks that it arises from the cuticularization of small particles of the palisade cells. Junowicz,[16] after an exhaustive study, finds that the light line is present only in palisade cells; that the cell-wall at this place refracts light strongly, and that the refraction not due to a chemical change in the cell-wall, i. e., cuticularization. Beck[17] says that it cannot be due to a cuticularization, nor is there a difference in the amount of water contained in that part of the cell-wall, although there are certain chemical and physical differences.

Immediately under the palisade cells are two layers of roundish cells of dark brown color. The number of integuments in the different species studied is the same, and the number of layers of cells in each integument is practically the same.

ALTHÆA ROSEA Cav.; fig. I.—In specimens of A. rosea the outer integument, *a b*, has both layers of cells developed, the outer layer, *a*, being developed rectangularly in a tangential direction. This layer gives rise to the epidermal outgrowths, or seed hair. The next layer, *b*, is nearly isodiametric.

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[11] VOGEL: l. c. Vol. XIX. pars II, taf. XLIII, fig. 55, 58; taf. XLV, fig. 77, 80. Nova Acta der Leop. Car. Academie.

[12] O. MATTIROLLA: La linea lucida nelle cellule Malphigiani degli integumenti seminali. Mem. della R. Acc. delle Sc. di Torino. Ser. II, Vol. XXXVII. See abst. Just's Bot. Jahresb., 1885. p. 825.

[13] RUSSOW: Vergleichende Untersuchungen über die Leitbundel-Kryptogamen, pp. 32. St. Petersburg, 1872.

[14] SEMPOLOWSKI: Beitræge zur Kenntniss des Baues der Samenschalen, p. 11, Leipzig, 1874.

[15] LOHDE: l. c., p. 30, 36.

[16] JUNOWICZ: Die Lichtlinie in den Prismenzellen der Samenschalen, p. 3, p. 18; p. 17. Prag, July 12, 1877.

[17] GUNTHER BECK: Vergleichende Anatomie der Samen von Vicia und Ervum, pp. 32. Sitzb. d. k. Akad. d. Wissensch. Band LXXVII. I. Abth. Mai Heft. 1878.

There is no deposition of intercellular matter in this integument nor between the two integuments. The palisade cell, *c*, is of moderate size. The cell cavity is nearer the upper end than ordinary. Nodosity is not often present. The light line, *l*, is not so sharp or distinct as in many species. The sub-palisade portion, *d*, is made up of a layer of large cells and several small ones. The small cells are narrow. The whole is of a chestnut brown color. The endospermal covering, *e*, is rather delicate. The first layer of cells in the endosperm, *f*, is made up of regular cells.

Measurements: seedcoats, 104μ; outer integuments, 29μ; outer layer of same, 11μ; inner layer of same, 18μ; palisade layer, 52μ; sub-palisade, 23μ.

MALVA SYLVESTRIS L.; fig. II.—The surface of M. sylvestris is rough in appearance. The second layer, *b*, of the outer integument, *a*, has been compressed into a thin layer and seems to have no definite arrangement. The outer layer, *a*, has been elongated radially. In places these elongated cells have divided forming a double layer of cells. There is no brown coloring matter in this integument nor is there any between the integuments. The palisade cells, *c*, are clear; the walls thick. The cell-cavity occupies about one-third the length of the cells, the lower end reaching to the middle. The nodosity is prominent. Below the cavity the cells are clear, almost transparent. The sub-palisade portion, *d*, is usually made up of two layers, at some places only one, of large dark brown cells.

Measurements: seed coats, 122μ; outer integument, 27μ; outer layer of same, 22μ; inner layer of same, 5μ; palisade layer, 70μ; sub-palisade, 25μ.

CALLIRRHOE TRIANGULATA Gray; fig. III.—The inner layer, *b*, of the outer integument is developed into isodiametric cells. The outer layer, *a*, is drawn out tangentially until linear. The cells are colorless and are closely contiguous to the palisade layer. The palisade layer, *c*, is clear throughout, with the borders of the cells sharply defined. Cell-cavity is large and near the upper end of the cells; nodosities prominent. The light line, *l*, is wide and sharply defined. The sub-palisade portion, *d*, is composed of two layers of cells, the cells of the upper layer having very thick brownish walls.

Measurements: thickness of seed coats, 90μ; outer integument, 9μ; inner layer of same, 6μ; outer layer of same, 3μ; palisade layer, 63μ; sub-palisade layer, 18μ; length of sub-palisade layer, 28μ.

CALLIRRHOE INVOLUCRATA Gray; fig. IV.—The outer layer, *a*, of the first integument is developed into large cells. This is just the reverse of C. triangulata. The cells are variable; some are isodiametric; they elongate gradually until some are almost linear tangentially. This layer is colorless. The inner portion of the palisade-cells, *c*, is almost transparent. The cell-cavity is very large and situated nearer the middle of the cell than in most cases. The light line is not sharp and quite near the outer end of the cell. The sub-palisade portion, *d*, is composed of two layers of large cells, the larger being nearer the palisade cells.

Measurements: seed coats, 62μ; outer integument, 8μ; outer layer of same, 6μ; inner layer of same, 2μ; palisade layer, 39μ; sub-palisade, 15μ.

MALVASTRUM ANGUSTUM Gray; fig. V.—The second layer, *b*, of the outer integument is developed into radially elongated cells. These cells are about twice as long as wide. The outer layer contains no coloring matter. The cell-walls between the first and second integument contain a small amount of yellowish coloring matter. On each side of the outer integument is a narrow band, *i*, that refracts light strongly. The palisade cells, *c*, are quite remarkable in having the clearest portion occurring outside of the cavity. This may account for the apparent dimness of the light line, *l*. The position of the light line is normal. The cell cavity is large and the nodosity prominent. The sub-palisade portion, *d*, contains one layer of very large dark brown cells. The large cells take a diagonal position. In some specimens they look like an . This is not quite so striking in *M. coccineum* Gray.

Measurements: seed coats, 104μ; outer integument, 9μ; second layer of same, 8μ; palisade layer, 65μ; sub-palisade, 30μ.

SIDA NAPÆA Cav.; fig. VI.—The outer integument, *a*, *b*, is composed of two layers of cells about equally developed. The shape in both layers is quite variable, from elongated radially to elongated tangentially. The cell-walls are colored yellowish brown.

The outer portion of the palisade cells, *c*, especially around the cell cavity, is more or less yellowish. The light line, *l*,

is not very prominent and quite near the end of the cells. The lower portion of the cells is colorless, almost transparent. The sub-palisade portion, *d*, is composed of two layers of cells. These cells are large, brown and elongated tangentially.

Measurements: seed coats, 120μ; outer integument, 24μ; palisade layer, 70μ; sub-palisade layer, 26μ.

ABUTILON AVICENNAE Gaertn.; fig. VII.—The outer layer, *a*, of the first integument is transformed into a strongly refractive layer. Thes econd layer is composed of radially elongated cells. The seed hairs arise from a single cell and are large and conspicuous. The hairs are spindle-shaped and thin walled; they occur mostly at the ends of the seed and are more or less pressed to it. There is little or no coloring matter in this integument excepting in the base of the hair cells. The palisade cells, *c*, are narrow for their length. The cell cavity is not prominent and the nodosity is inconspicuous. The light line is narrow and occurs near the outer end of the palisade layer. The sub-palisade portion, *d*, is made up of two layers of light brown cells. They are symmetrical and elongated tangentially.

Measurements: seed coats, 147μ; outer integument, 13μ; palisade layer, 96μ; sub-palisade, 38μ.

MODIOLA MULTIFIDA Moench.; fig. VIII.—The first layer, *a*, of the first integument is developed into tangentially elongated cells. The second layer, *b*, has been compressed into an irregular shape. This layer contains much yellowish coloring matter. The palisade layer, *c*, is clear, almost transparent, the cell cavity long and the nodosity not conspicuous. Both the cell cavity and the nodosity lack the yellow color usually present. The light line, *l*, is indistinct. The sub-palisade portion, *d*, seems to be made up of two layers of cells. The cells of the different layers alternate. The outer layer is composed of very large spherical cells. The second layer is also made up of spherical cells but not so large as the outer; both are of dark chestnut brown color. Below this is a thick portion of irregularly shaped cells of brown color.

Measurements: seed coats, 84μ; outer integument, 14μ; palisade layer, 32μ; width of same, 4μ; sub-palisade, 38μ; diameter of upper layer, 26μ; diameter of lower layer, 14μ.

HIBISCUS MILITARIS Cav.; figs. IX, X, XI.—The first layer, *a*, of the outer integument is most prominently developed. This layer gives rise to the seed hairs. These hairs, *h*, are spindle-shaped, with the walls thin and fragile. The walls of the basal cell are stronger than the neighboring cells. The seed hairs are made up of single cells each containing a small amount of granular matter at the base. The color of the integument is chestnut brown. Cells in the second layer, *b*, are elongated tangentially. The palisade layer, *c*, is composed of large cells, wide in comparison with their length. The cell-cavity is comparatively small, the nodosity prominent. The light line, *l*, is strong and large. Under ordinary magnification ($\frac{1}{8}$ objective) it appears as an unbroken band across the outer end of the cells. Using a strong magnification ($\frac{1}{10}$ or $\frac{1}{18}$ oil immersion) each cell-wall interrupts the line. The portion of the light line in each cell is divided or nearly divided into two or three bodies. Under an analyzer the light line takes on blue a little earlier than the adjoining field. When the field is most intense blue the light line is dark on the inner border and dark blue on the outer. Just before the section comes into focus the light line appears dark taking on the characteristic colors when in focus, while the color of the adjoining field does not depend upon the focus. A thick section shows the following colors under the analyzer, blue, green, yellow, pink. The colors appear only above the cell-cavity. The portion below the cell-cavity gives only blue and yellow distinctly. The cell-cavity agrees with the upper portion of the cells. The nodosity does not change polarized light. The other cells of the seed-coat give no decided reaction under the analyzer. After isolation a cell parts easily immediately below the cavity and sections often behave in a similar manner. The cells, fig. X, are usually pentagonal and somewhat elongated in the direction of least circumference. (Fig. XI.)

The sub-palisade portion, *d*, is composed of three prominent layers and a number of less regular closely massed cells. This layer has a great amount of dark coloring matter, which is a dark chestnut brown.

Measurements: seed coats, 187μ; outer integument, 26μ; outer layer of same, 17μ; inner layer of same, 8μ; palisade layer, 103μ; sub-palisade layer, 58μ.

Lake City, Fla.

Evolution in methods of pollination.

ALICE CARTER.

In attempting to arrange our phanerogams in a natural order, I have been astonished at the close resemblance even in external appearance between the reproductive organs of Coniferæ and Pteridophyta; at the Equisetum-like arrangement of the spore cases (anthers and ovules) in many of our exogenous trees, such as Alnus and Betula, whose inflorescences are not highly specialized; and at the return to the moss-like or frond-like form of degenerate water plants, e. g., Lemna, Wolffia and Myriophyllum. The essential similarity in the life processes of all the higher plants, pteridophytes and phanerogams, is a fact familiar since the days of Hofmeister, and is constantly receiving confirmation. For instance, Stengel has recently described the beautiful transition in anatomical structure and origin between the macrosporangia (ovules) of gymnosperms and angiosperms. The discovery of such analogies is one of the great achievements of modern botany, making it possible, by embryology and histology, to trace the ascent from mosses to exogens, picturing to us the development which geology shows has been going on in time.

Variation is the source and presupposition of this development. Change of conditions and cross-fertilization are the two great known causes of variation. The first, in the case of fixed plants works slowly; the second includes within itself the advantages of the first and others of its own; for by it the characteristics of dissimilar parents, whose differences are to a certain extent the results of the dissimilarity of the conditions to which they have been subject, are transmitted in varying proportions to succeeding generations. New properties are thus acquired and old ones changed, and the variable descendants of crossed plants conquer the unimproved offspring of self-fertilization.

The process of conjugation in the lowest plants in which there is a sexual reproduction, in almost all cases makes probable the union of the spores of two distinct individuals (Spirogyra, Mucor, Desmidiaceæ, Diatomaceæ, etc.), while the same possibility of cross-fertilization is insured among the higher thallophytes, liverworts and pteridophytes by motile antherozoids, which are so small that the moisture of the damp places in which

the prothallium or sexual generation always grows is sufficient to carry them, sometimes at least, to the germ cells of distinct plants. The wind, too, helps as the means of scattering the asexual spores from which the sexual generation grows.

Among phanerogams the power of elongation of the antherozoid-bearing pollen tube takes the place of the movement of the antherozoid itself, but still the asexual spores of pines, grasses, sedges, and of many forest trees are carried by the wind to the oospheres which they fertilize. Most of these anemophilous plants are probably old types; the Coniferæ, for example, which are all anemophilous, are acknowledged to have been the precursors of the higher monocotyledonous vegetation. They are all anemophilous. Geologists tell us that monocotyledons appeared before exogens; their structure is simpler and they are in many respects a connecting link between these and gymnosperms. Five of the 22 orders of endogens described in Gray's Manual (revised edition) are anemophilous, a large proportion; one is partly wind-, partly water-fertilized; several others are largely hydrophilous, also a primitive method common among degraded water plants such as Vallisneria and many Naiadaceæ.

The very fact that whole orders of endogens have this characteristic of wind-fertilization proves it to be an ancient one, for the features which are common to all members of an order are necessarily as old as the order itself, and the possession of the same property by several orders of a class indicates still greater age. The wide distribution of some of their genera (there is none wider among phanerogams) and the comparative lack in variety of the Cyperaceæ, Gramineæ, Juncaceæ, Eriocauleæ and Typhaceæ point to the one conclusion, that these wind-fertilized endogens are among the oldest of flowering plants.

For somewhat similar reasons many of the anemophilous dicotyls may be considered old types. They are almost all apetalous—a sign of low development; a sign, too, of old age, for the apetalous was the dominant type of dicotyls in the mid-Cretaceous, forming forty-five per cent of them as against fourteen per cent now. This decrease in numbers is suggestive of extinction and another mark of old age. Further, of the twenty-three apetalous orders represented in our flora, six are anemophilous. These are the Salicaceæ, Cupuliferæ, Myricaceæ, Juglandaceæ, Platanaceæ and Piperaceæ. (Excep-

tion must be made of the genus Salix which has developed means of insect attraction). Of these the Salicaceæ are known to be old, for the oldest fossil dicotyledons are of the genera Salix and Populus. None of them include many genera, and this again is a common attribute of old orders and a sign of approaching extinction, according to Darwin's rule that the dominant orders are those of numerous genera and species.

Piperaceæ	include	8	genera	and	1000	species.
Platanaceæ	"	1	"	"	6	"
Juglandaceæ	"	5	"	"	30	"
Myricaceæ	"	1	"	"	35	"
Cupuliferæ	"	10	"	"	400	"
Salicaceæ	"	2	"	"	200	"

The genera are conspicuously few. The Piperaceæ alone have a large number of species and of their method of fertilization I am not sure. The group Saurureæ, represented in our flora, is apparently adapted to wind-fertilization. Moreover many members of the Chenopodiaceæ, Amarantaceæ, Polygonaceæ, Urticaceæ and some Empetraceæ are anemophilous. All this is in marked contrast to the state of things among the younger and more highly developed exogens. For of the 50 polypetalous orders one is partly wind, partly water-fertilized; of the 33 gamopetalous orders, only one is largely anemophilous, and of that one, the Plantagineæ, the typical genus is considered by some authorities to be degraded.

Here, too, the question of color comes to our aid. In every one of these ten apetalous orders the predominance of greenish inflorescences is very noteworthy as a further sign of low organization and of relationship with glumaceous endogens, pines, and pteridophytes. F. F. Mott[1] says that dull color means the absorption of vibrations of every wave length; deep red, deep violet or green that about two-thirds of the wave lengths are absorbed, about one-third reflected; scarlet, yellow, blue or purple that about one-third of the wave lengths are absorbed, about two-thirds reflected. He adds that these three stages of color show therefore three stages of progress in the direction from generalization to specialization, a progress such as marks all development. Accordingly we should expect to find, as we do, greenish and dull shades prevalent among the least highly organized, and

[1] American Naturalist, Sept. 4, 1890.

therefore, other things being equal, the oldest inflorescences. On the other hand, among the dominant forms of to-day, the greatly specialized Compositæ, Umbelliferæ, Leguminosæ, Orchidaceæ, Labiatæ, Scrophulariaceæ, Rubiaceæ, Ericaceæ, etc., bright reds, blues and orange yellows are common. There are 23 orders of the world flora which contain 1000 species or more. Inconspicuous flower clusters are characteristic of only five of these, viz: the Cyperaceæ, Gramineæ, Urticaceæ, Piperaceæ and Euphorbiaceæ. The first and second are very old types, the third and fourth apetalous (probably old), the last degenerate.[1] It seems then logical to call these inconspicuous, little protected clusters of stamens and pistils ancient forms of flowers and to consider wind-fertilization, which is so common among them, a primitive method.

But the crossing of individuals must be a most desirable thing if it is to be obtained at such enormous cost, for pollen is precious material, yet for every grain which the wind carries to an ovule thousands are swept to destruction. Self-fertilization would apparently be a much surer and cheaper process. The end, however, justifies the means, otherwise crossed plants would long ago have yielded place to self-fertilized victors. Darwin, by a most careful and elaborate series of investigations of more than a thousand plants, has shown that "wherever plants which are the offspring of self-fertilization are opposed in the struggle for existence to the offspring of cross-fertilization, the latter have the advantage. In no single case was the advantage on the other side."[2] So wind-fertilized plants waxed strong and multiplied on the face of the earth.

Meanwhile "away back in the darkness of the coal period, when tree-ferns, calamites and giant club-mosses combined with archetypal yews to people the steaming swamps of a hot, cloud-laden island world, there existed a strange form of insect which can only be compared to the cockroaches of our day, but which seems to have embodied in its structure the beginnings of all the varied types of insect life, the promise and

[1] White and yellow are the predominant colors of our own flora; 420 yellow, 614 white species among the 2056 flowers of Gray's Manual (revised edition). It would be interesting to know whether there is a larger proportion of reds and blues in the tropical lands where flower-frequenting birds and butterflies are more abundant. Wallace's statement of the surprising monotony of tropical vegetation is not necessarily opposed to this.

[2] H. Müller.

prophecy not only of our dragon-flies, and beetles, but also of our flies, bees and butterflies."[8] Scudder sums up what was known of American fossil insects about nine years ago in this way: "The species of fossil insects known from North America number eighty-one; six of these belong to the Devonian, nine to the Carboniferous, one to the Triassic and sixty-five to the Tertiary epochs; the Hymenoptera, Homeoptera and Diptera occur only in the Tertiaries; the same is true of the Lepidoptera, if we exclude the Morris specimen, and of the Coleoptera with the Triassic exception. The Orthoptera and Myriopoda are restricted to the Carboniferous, while the Neuroptera occur both in the Devonian and Carboniferous formations." Packard says: "the lower forms of Hymenopera, so far as the scanty records show, appeared first in the Jura formation."

From these statements its seems probable that the period of the appearance of dicotyledons was also the time of the development of our great groups of insects. The two have been hand in glove ever since. Insects wandered to and fro seeking what they might devour, and if the man is blessed who makes two blades of grass grow where only one was, thrice happy is the insect which discovers an entirely new source of nourishment by which its food supply is many times multiplied. Accidentally lighting on a staminate flower cluster, as I have seen bees and flies do on the wind-fertilized inflorescences of Poterium Canadense, it finds itself in the land of plenty and thereafter is on the outlook for food-magazines of the same kind. The flowers with highly colored bracts (represented in the flora of to-day by some species of Euphorbia and Amarantus), or those with colored stamens, (such as species of Thalictrum, Corema and Plantago now show as the first step toward insect attraction), being more conspicuous will be more frequently visited. Visitors leaving the flowers carry with them pollen which clings to the hairs of their bodies, and some of this will occasionally be left on the feathery stigmas of the pistillate clusters which will also be visited, at first in vain. The ovules so fertilized ripen seeds which inherit the peculiarities of their parents to a greater or less degree.

This is then, as far as we know it, the story of the origin of flowers, which were at first merely axes bearing spirally ar-

[8] Lester F. Ward.

ranged reproductive organs, such as the antheridial and archegonial clusters of mosses or the spore-bearing stalks of ferns and equisetums. The growth of bracts, i. e., leaves altered to do protective work, and the further development in the macrosporangium mouth of the mucilaginous secretion already foreshadowed in the archegonia of ferns, produced the characteristic inflorescences of gymnosperms. The position of a plant, as of a man, in the scale of progress, is measurable by the protection given to the children and by the manner of their preparation for independent life. The increase of ovule-shelter by the formation of a closed ovary is an easy step, as the comparison of the ripened pods of Mitella, Tiarella, Aquilegia or almost any of the Leguminosæ with the ovule-bearing scales of pines, shows. By the incurving of the edges of one of these scales, or more probably, by the persistence of the inrolling of the edges of the young leaf, an ovary perfect in every essential would be produced, and the favorable variation transmitted to succeeding gererations.[1] Still further provision for the safety of the seeds and for their advancement in life, is attained by increased development of the protective bracts to form organs such as the perigynia of sedges, the glumes and awns of grasses, the hairs of Eriophorum, etc.; more complete adaptation to wind-fertilization by the formation of microsporangium stalks (filaments, sometimes feebly developed in the Coniferæ) and of feathery outgrowths (stigma) from the united tips of the carpellary leaves.

Then the lords of horticulture, the insects, with an eye to profit, began their investigations of the fields, at first obtaining only pollen from these wind-tossed inflorescences. In some cases they never find anything more, e. g., in Hepatica and Papaver. But the occurrence of sugary secretions,

[1] Some time after writing this sentence, I came across a remarkable confirmation of the truth of the theory in Eichler's "Blüthendiagramme," part II, p. 216. He says: "In most Resedaceae the carpels are so united that they form a one-celled ovary with parietal placentae, . . yet they remain free from one another at the top, nor do the edges of the individual carpels close together there, so that the ovary is open above. . . . The condition of things is somewhat different in Reseda luteola, Caylusea and Astrocarpus. In the first species the individual carpels remain separate, their edges turned inwards and meeting below to bear the ovules in the ordinary way, but not touching above so that each carpel is open far down on its inner suture. In Caylusea there is neither union of the carpels, nor closing together of the edges of each one separately; the ovary *appears therefore to be made of five or six free scales which stand in a circle*—a very primitive structure, not occurring elsewhere in this form." The state of things in Tiarella cordifolia seems to me to correspond well to this description of the pistils of Reseda luteola.

common elsewhere, as on the petioles of the passion vine and on the leaves of the larch where bees busily search for them, among the floral organs is a not surprising result of the energy of the currents which nourish anthers and ovules.[1] Such secretions at first perhaps not abundant, nor perceptibly sweet, will be gradually increased and improved by means of this co-working of plant and insect. Stages in the evolution of nectar and of nectar-protecting organs are represented to-day, steps which connect the watery fluid found exposed the first day of blossoming in the stigmatic cavity of Nymphæa tuberosa, the drops of liquid at the bases of the carpels of Caltha, the honey protected by scales on the petal bases of Ranunculus and by elongated petal-bases (i. e. spurs) of Aquilegia, etc., with the showy buckets of Marcgravia from which the brilliant sun birds of India drink nectar worthy of the gods.

The result of this long-standing partnership is, that, in the place of a world of green, corolla-less flowers, our meadows are rich with the gold of daisies and buttercups; our hillsides, covered with the blue of innocence; our rocks, purple with clematis, or gay with columbine; asters and golden-rods reflect royal colors in the brooks; gentians give back the blue of the sky from the mountain pastures; and there are glorious fringed orchids for those who can find them, and they are the bees and butterflies. For the good poet was mistaken in supposing that many a flower is born to blush unseen. The bees who have made it blush will surely be there to see.

Ithaca, N. Y. [*Concluded next month.*]

Mt. Kataadn and its flora.

F. LAMSON-SCRIBNER.

In August, 1874, a party of gentlemen from Bangor and Orono, under the direction of President M. C. Fernald of the Maine State College, made the ascent of Mt. Kataadn for the purpose of determining more accurately than had before been done, the altitude of the mountain. This work was accomplished by Prof. Fernald in a very thorough and accurate manner, and his observations were made public at that time.

Mr. F. W. Hardy, a well known photographer of Bangor,

[1] cf. BONNIER: Comptes Rendus, LXXXVIII. 662.

accompanied the party and succeeded in obtaining some excellent stereoscopic and other views of the mountain and its surroundings.

From Bangor we proceeded by rail to Mattawamkeag, thence thirty-five miles by stage to Sherman. From the latter place we were carried with our baggage, by private conveyance through Stacyville to "Hunt's Farm", on the banks of the East Branch, a distance of ten miles. An excellent guide was procured at Stacyville, in the person of Mr. J. C. Stacy, a gentleman who very faithfully served us on a similar excursion the year before.

Hunt's Farm was then owned by a Mr. Patterson, a stalwart and obliging man who had about him a large family of bright and healthy boys and girls. Mr. Patterson's nearest neighbors were distant about six miles, and his hospitable dwelling, which served as a hotel for the lumbermen in the winter season, was the last one on our route to the mountain. We crossed the river in a bateau and the remaining twenty miles of our journey were through a continuous forest, which we traversed on foot. There was a good logging road to within two or three miles of the mountain, so that our walk was not a severe one. Indeed a person might ride on a sure-footed horse the greater part of the distance. Within the first six miles we twice forded the Wissatiquoik River, which empties into the East Branch near "Hunt's Farm". The fords were easily and quickly accomplished, but at the second crossing our task became more laborious for we were then obliged to assume the burden of our provisions and blankets which thus far had been transported by horses.

Five miles farther on, at the foot of Kataadn Lake, we had our first good view of the mountain, sharply and boldly defined against the western sky. The sight inspired us with new courage and enthusiasm, and after a brief rest we hastened on, and near the close of the third day from Bangor we arrived at the foot of grand old Kataadn, with its naked summit majestically towering directly above us. After a good night's rest and an early breakfast we prepared for the real labor of our excursion, that of the ascent, but with it came the real enjoyment which we so long held in anticipation.

Without a load one may ascend the mountain from the foot of the eastern spur, or "ridge" as it is termed, and return in a day. But a person unused to such scenery will form but a

vague idea of the mountain if he makes but one ascent. He must ascend and reascend; he must dwell upon its lofty peaks and view in varying lights its grand proportions; he must descend its vast slides filled with decomposed granite and immense boulders that appear as though the slightest push would send them rolling down the mountain side; he must descend the "long crooked slide" where by a slip he might be dashed upon the sharp rocks hundreds of feet below or where an incautious step might set in motion an avalanche of huge boulders; he must pass down into the "notch" and over the "chimney"—a feat seemingly impossible to the inexperienced. The "narrows" must be traversed, where there is barely a footing and from whence a jump of more than two thousand feet may be made upon the one hand or a tumble hardly less great upon the other. The "northern tablelands" must be visited, and the mountain "basin", where exists a small lake of the purest water. This basin is enclosed upon three sides by perpendicular walls of solid rock, nearly two thousand feet high. All this must be done and more, ere one can obtain any correct impression of the grandeur and immensity of this mountain.

Situated in the eastern part of Piscataquis County, and in the very heart of the lake and mountain scenery of Maine, Mt. Kataadn stands without a rival in New England in the wild grandeur of its proportions: and in its alp-like character it has no equal in the Eastern States. The altitude, as determined by the observations of Prof. Fernald, is five thousand two hundred and fifteen feet, making this mountain the highest point of land in the state and but a little lower than Mt. Washington in New Hampshire. The views to be obtained from its summit can hardly be surpassed either in beauty or extent. The peculiar features of the flora of this locality cannot fail to be of interest to the student of botany, and it is our purpose to present in this paper some botanical notes made during our stay upon the mountain.

Upon a previous visit (in 1873) we made the ascent by the way of the "eastern slide", which is, perhaps, the easiest if not the best place for the purpose. Around the base of this slide a small form of the white birch is the prevailing tree; probably *Betula papyracea*, var. *minor* Tuck. Ascending the slide, this tree rapidly dimishes in size, till finally it becomes a mere dwarf and disappears entirely before reaching the first

"horseback". The lower portion of the mountain is covered with a dense growth of dwarf black spruce, so dense as to be wholly impassable, except by tumbling or rolling over the summits of the closely growing trees.

At the foot of this slide along the borders of a cold mountain stream, grows the bright-flowered *Arnica mollis* Hook. Dr. Goodale in the Report of the Maine Board of Agriculture for 1862, in speaking of this plant, says: "It is found sparingly near Moxie Falls, a few miles from the forks of the Kennebec. It occurs in great beauty and profusion in the vicinity of the cataract of Parlin Pond stream, where its orange flowers are sprinkled with the spray of the falling water. The iridescence of the flowers as they were bathed in the sunlight and spray was a spectacle of much beauty, the orange blossoms here and there, overpowering the rainbow coloring of the drops of water."

Nearly half way up the slide, an ice-cold spring issues from the side of the mountain, and its waters, rushing down over the steep rocks, form the brook just alluded to. Along this stream the green mountain alder, *Alnus viridis*, grows in luxuriance. Above the spring this shrub gives way to more alpine forms: we soon meet the dwarf birch (*B. glandulosa* Mx.), a rather pretty little shrub abundant on the high mountains of New England and New York, and growing as far north as Hudson's Bay. Fruited specimens less than three inches high were gathered on the "horseback". With the birch and extending above it, we find the little mountain cranberry, *Vaccinium Vitis-Idæa.* This is a low spreading shrub with numerous short, upright branches. The berries are numerous, of a dark red color, with an acid taste. They are gathered and made into sauce, like the common bog cranberry. The sweet berries of the bog bilberry, *V. uliginosum* L., and mountain blueberry, *V. cæspitosum*, refreshed us on our tedious ascent. At the summit of the slide, occurring quite frequently and rising but an inch or two above the rocks on which it grew was Cutler's willow, *Salix Cutleri* Tuck. It may be recognized by its strongly veined, elliptical leaves. With this species occurs also *S. herbacea* L., a species of even smaller habit than the last.

Forming dense, convex mats over the surface of the rocks is the curious *Diapensia Lapponica* L., a small evergreen plant of the Phlox family. The remains of the white flowers, which

appear in July, were still present. As we neared the summit of the slide, the crowberry, *Empetrum nigrum* L., made its appearance. This is a small, prostrate, much branched shrub, with very numerous, narrow leaves, giving the plant a heath-like aspect. The flowers open in early summer. In August, the plants were loaded with small black berries. Ascending the "Horseback" towards the "Chimney", we passed large patches of the beautiful little mountain sandwort, *Arenaria Grœnlandica.* The flowers of this species are quite large when compared with the plant and are of a delicate white tint.

Upon our present trip we started from Reed's camp and proceeded through dense groves of tall spruce trees, which became smaller and yet more dense as we advanced towards the eastern spur, up which we were to climb, and such a climb! With our packs upon our backs, and no path, not even a spotted line to direct our course! We come upon huge boulders over which we must climb, or around which we must force our way through an almost impenetrable forest of dwarf birch and stunted fir. By dint of perseverance and severe exertion, we labor upward; now walking almost upon the very tops of the low but wide expanded evergreens, now losing our footing and slipping helplessly into dark caverns between high and mossy rocks. Two hours, or perhaps more, of this travel and we are above the growth of trees and have passed through that dense growth of vegetation called by the woodsmen "pucker-brush". We are now more than three thousand feet above the sea level. Our birch tree exists only as a low shrub and soon gives way to another species, the little *Betula glandulosa*, which rises but a few inches above the rocks upon which it grows, or rather to which it clings. About us there is still to be seen an occasional spruce, but so reduced in size that we can hardly recognize in it any relationship to the majestic forms that clothe the hills now far below us. For how many centuries the stunted forms before us have braved the severe mountain storms and fierce winters we know not, but that their whole existence has been one constant warfare with the untamed elements their meager and ancient appearance will testify—the vertical trunks rising but a few inches above the stony soil, the densely grown and thickly clothed branches carpeting the rocks like some sharp leaved moss. A few steps upward and we are in the midst of plant forms that belong to the frigid zone. Here in profusion we find the small moun-

tain blueberry, *Vaccinium cæspitosum*, the mountain cranberry, *V. Vitis-Idæa*, and the heathlike crowberry, *Empetrum nigrum*, plants that abound in Greenland and furnish berries that form the only vegetable diet of the dwellers in that arctic country.

The only species peculiar to Mt. Kataadn is *Saxifraga stellaris*, var. *comosa*. The other forms, so far as noted, are identical with those upon the White Mountains and other high altitudes in the United States. The upper limit of erect shrubs is between three and four thousand feet.

Below is a list of those plants observed upon the mountain or in its vicinity.

1. *Clematis verticillaris* DC. Abundant along the banks of the East Branch, in fruit. This vine grows in profusion at Orono, Maine, where it blooms about the 25th of May.

2. *Cardamine bellidifolia* L. In the "Long Crooked Slide" which runs down from near the highest peak of the mountain.

3. *Arenaria Grœnlandica* Spreng. Common on the rocks of the Eastern Ridge, or "Saddleback". Although perfectly at home upon the bleak mountain tops of New England, it is sometimes found in Maine upon the rocky river banks near the sea.

4. *Saxifraga stellaris* L. var. *comosa* Willd. Found only under the shade of rocks on the ridge north of the summit of the mountain. The flowers of all the specimens I saw were changed into little tufts of green leaves.

5. *Epilobium alpinum* L. Only one or two specimens seen in the "Basin" of the mountain.

6. *Linnæa borealis* Gronov. Common in damp woods throughout the State, blossoming about the middle of June. I found it growing in damp moss on several of the lower points of the mountain in bloom at the time of my visit (Aug. 15).

7. *Nardosmia palmata* Hook. Noticed in swamps near the mountain. It grows in great abundance at Orono, Maine.

8. *Aster graminifolius* Pursh. On dry rocks of the East Branch.

9. *Solidago Virga-aurea* L. var. *alpina* Bigel. In several places on the mountain. This is a bright little species of golden-rod and often expands its heads of golden yellow flowers barely an inch above the rocks on which it grows.

10. *Solidago thyrsoidea* E. Meyer. Common, especially

in the "Long Crooked Slide", and near the northern "Table Lands".

11. *Gnaphalium supinum* Villars. On rocks in the "Basin". The specimens were out of bloom.

12. *Arnica mollis* Hook. Near the foot of the Eastern Slide and also along the borders of a lake near the "Eastern Spur" of the mountain, where it is very abundant.

13. *Cirsium muticum* Mx. Common near the mountain.

14. *Nabalus nanus* DC. Common on the higher portions of the mountain, especially near the northern "Table Lands".

15. *Nabalus Boottii* DC. With N. nanus, but not so abundant.

16. *Lobelia Kalmii* L. Abundant on rocks along the East Branch. I have also found this plant on the banks of the Kennebec at Waterville.

17. *Campanula rotundifolia* L. A diminutive mountain form grew in the "Notch" near the "Chimney". The plants were only four inches high, simple, terminated by a single flower.

18. *Vaccinium Vitis-Idæa* L. Common especially on the "Saddleback". Upon the shady and moss-covered rock-shelves on the north side of the "Chimney", specimens were gathered in flower. This is the mountain cranberry of the north. The slightly acid, refreshing berries are collected in quantities for making sauce and preserves.

19. *Vaccinium uliginosum* L. Common.

20. *Vaccinium cæspitosum* Mx. Is a very small species producing sweet, blue berries,—also common.

21. *Vaccinium Pennsylvanicum* Lam. The alpine variety of this species (var. *angustifolium*) grows on the north "Table Lands."

22. *Chiogenes hispidula* T. & G. Common on the lower portion of the mountain, also in swamps throughout the state.

23. *Arctostaphylos alpina* Spreng. Quite common on the higher altitudes. In fruit.

24. *Cassiope hypnoides* Don. This charming little heath-like plant I found only on the eastern edges of the north "Table Lands". The plants were in fruit.

25. *Kalmia glauca* and *K. angustifolia.* Found on the "Saddleback". The former in flower.

26. *Phyllodoce taxifolia* Salisb. Common along the "Narrows".

28. *Rhododendron Lapponicum* Wahl. North "Table Lands".

29. *Loiseleuria procumbens* Desv. On rocks north of the summit, common.

30. *Moneses uniflora.* In flower on the northern portions of the mountain and throughout the state in cool swamps, blooming about the last of June.

31. *Diapensia Lapponica* L. Abundant on the "Saddle-back". In fruit.

32. *Polygonum viviparum* L. Found only in the "Long Crooked Slide," in flower and fruit.

33. *Empetrum nigrum* L. Very abundant in the eastern portion of the mountain.

34. *Betula papyracea* Ait. var. *minor* Tuck. Common on the lower portions of the mountain.

35. *Betula glandulosa* Mx. Common on the mountain. Well fruited specimens less than three inches high were collected.

36. *Alnus viridis* DC. Common on lower slopes along streams.

37. *Salix argyrocarpa* Anders. Common.

38. *Salix herbacea* L. On the "Saddleback", in moss.

39. *Scheuchzeria palustris* L. In a bog near the mountain.

40. *Listera cordata* R. Br. In flower in the sag between the summit and the north "Table Lands."

41. *Orchis dilatata* Gray. Common in the swamps near the mountain.

42. *Luzula parviflora* Desv., var. *melanocarpa.* Abundant.

43. *Luzula spicata* Desv. Common.

44. *Juncus filiformis* L.

45. *Juncus trifidus* L. Common.

46. *Scirpus cæspitosus* L.

47. *Carex scirpoidea* Mx. Abundant on the eastern dome of the mountain.

48. *Carex canescens*, var. *vitilis.* At the very summit of the mountain.

49. *Carex lenticularis* Mx. In the "basin".

50. *Carex rigida* Good. var. *Bigelovii.* On the "narrows", and also in great abundance northwest of the summit.

51. *Carex pulla* Good. ? On the shores of the little lake in the "basin".

52. *Cinna pendula* Trin. Along streams near the mountain.

53. *Calamagrostis Canadensis.* Along the mountain brooks.
54. *Poa laxa*, Hænk. On the "Saddleback".
55. *Aira flexuosa* L. Common.
56. *Hierochloa alpina* R. & S. On the "Saddleback".
57. *Lycopodium Selago* L. Abundant along the "Narrows", etc.
58. *Lycopodium annotinum* var. *pungens.* On the Eastern Ridge.

NOTE.—The foregoing article was written in 1874; the nomenclature therefore conforms to that of the 5th edition of Gray's Manual.—F. L. S.

Knoxville, Tenn.

Noteworthy anatomical and physiological researches.

Observations on the protection of buds in the tropics.[1]

While no little attention has been given to the way in which buds are protected from the cold of rigorous climates it would appear that similar adaptations to guard the delicate parts of plants from the hot and dry atmosphere and the direct rays of the sun in tropical regions have been the occasion of much less study, although this is quite as distinct and considerable a field of research. Treub called attention to the need of such adaptations in 1887, and gave several instances of their occurence. The paper of Potter here summarized is, however, the first to give any satisfactory classification of the various methods employed by different plants, so far as the writer is able to discover. "For the purpose of description," says Potter, "it is convenient to consider these special protective contrivances under four heads," as follows:

1. Protection by means of stipules. 2. Protection by means of gum. 3. Protection by position assumed when young. 4. Protection by shade from older leaves.

Species of Artocarpus, Heptopleurum, Canarium, Wormia and Sarcocephalus are cited as examples of the first class. In all these the stipules form a hood over the young leaves and thus protect them from the too scorching rays of the sun. Of the second class Tabernæmontana is mentioned as particularly interesting. In at least one species of this genus the young leaves develop in a four-sided chamber, the walls of

[1] M. C. POTTER: Journ. Linn. Soc. XXVIII, 343–352.

which are, on two sides, older leaves, and on the other two, thin layers of gum. As an instance of the third case the orthotropic position of folded palm-leaves is mentioned. It would scarcely seem permissible to put forward a case like this as an instance of special adaptation, for, as is well known, it is generally true that rolled-up dorsiventral organs are inclined to take the erect position. Undoubtedly, nevertheless, such a position is of decided value to the young leaves and parts of leaves for it clearly serves to put them in the least exposed position with reference to the incident rays of a hot tropical sun. Many examples of this manner of protection may be found among the monocotyledons in particular. The last method of protection is a favorite one and is by no means confined to plants growing in the tropics. Uvaria, Gossypium and Begonia are the examples cited by Potter. In each of these genera when a leaf has become old enough to resist the hot rays of the sun and the unfavorable conditions of the atmosphere it is quite natural that it should be utilised as a protecting shield for the immature leaves which are less able to withstand conditions varying so widely from the optimum.

Some good figures are given in the plates which accompany the article, and, with the exception of the third, each class is illustrated.—CONWAY MACMILLAN.

Vitality of ferns.

Wittrock publishes in a recent paper[1] a series of observations, which form together a very valuable contribution to the biology of the ferns. It deals especially with the ability of fern-leaves to imbibe water and to become fresh after a long period. Several species are described as showing this power and the author has observed that a special form of the frond is characteristic of each species, when naturally dried. Most interesting, however, is the chapter in which the author demonstrates the ability of the ferns to be revivified after being kept dry for several months or even years and after being preserved as herbarium specimens! Professor Wittrock has taken, for instance, several species from the Pringle-collections immersed them in water for some minutes and then planted them in moist sandy soil, keeping them carefully in shade and under an ordinary glass globe. The ferns became perfectly

[1] V. B. WITTROCK: De filicibus observationes biologicae. Acta horti Bergini, vol. I. no. 8. Stockholm, 1891.

fresh and developed new leaves and roots, although some had been preserved in herbaria for two years and three months. The Mexican plants which Prof. Wittrock succeeded in reviving were: *Scolopendrium nigripes; Asplenium furcatum, A. Pringlei; Polypodium Plumula, P. lanceolatum; Cheilanthes lendigera, C. Szovitsii; Isoetes Pringlei. Selaginella lepidophylla*, the well-known resurrection-plant, was also cultivated, and specimens which had been kept dry in a jar for more than eleven years revived. The paper is illustrated by five partly colored plates.—THEO. HOLM.

Anatomy of carices.

A very comprehensive study of the anatomical structure of about fifty species of *Carex* has been made by M. Mazel, forming a very welcome addition to the papers which deal with anatomical characters of species. Although the author admits that he has not succeeded in finding any characters in this genus sufficient to characterize the different groups of species, he has at least made a beginning by enumerating a considerable number of peculiarities in the internal structure which undoubtedly may serve in the future as a basis for a more complete study of this genus. It seems, however, that the species selected for examination are not quite sufficient to illustrate the whole genus anatomically. For it must be remembered that we have here to do with an exceedingly large genus, of which the representatives are spread all over the world and living under the most different conditions as to climate and soil. This has not been taken into consideration, and instead of selecting about fifty species, all European excepting one, it would have been more advisable to examine the same number representing other parts of the world. North America posesses very many and most interesting species of *Carex*, which ought not to have been passed by in a "comparative" anatomical study. The Arctic region also has a considerable number of types, many of which appear again farther south, and of which the structure is better suited to illustrate the genus anatomically than a number of species from a relatively small territory. It would also have been highly desirable for the author to give a sketch of the modified structure in the varieties of a few species. This is for in-

ANTOINE MAZEL: Etudes d'anatomie compareé sur les organes de végétation dans le genre Carex. pp. 213 7 plates. Genève 1891.

stance well marked in the different forms of *Carex vulgaris*, *hirta*, etc.

It is a little curious to see that the author considers the character of hairiness as being so very rare in Carex, and that he only mentions this fact for *C. hirta*, while it is also to be found in *C. pallescens*, *pilosa* and many North American species, e. g., *C. virescens*, *castanea*, *aestivalis* and *triceps*.

But otherwise this paper contains many interesting details and proves a skillful and careful research. The first chapter gives a general view of the structure of the vegetative organs, while the second contains a microscopical analysis of the species.

Concerning the leaf-structure the author points out several divergences, taken from the epidermis itself, the stomates, the epidermal expansions, the strength of the stereome, the distribution and shape of the mestome bundles, the reservoirs, etc. Among the reservoirs the author has discovered that those containing tannin are present in several species. He has observed them in the mesophyll, close to the lacunes and just under the epidermis. This is the more interesting since the Cyperaceæ formerly like the Gramineæ and the Ranunculaceæ were considered exceptional in not possessing any reservoirs.[1] The author has, however, not only observed them in the leaf but also in the aerial stem and the rhizome of certain species.

The general structure of the leaf seems to be very uniform, there being a whole series of intermediate forms between the nearly triangular leaf of *C. Davalliana* and the broad and flat leaves of *C. maxima*, *riparia* and others.

There is also given a very detailed account of the tissues in the aerial stem and the rhizome. The aerial shows like the leaf a general plan, which is, however, still more distinct than in the leaf. The epidermis does not show so many differences as in the leaf with its superior and inferior face, and it is rather difficult to observe any essential divergences. It might seem that the sharply triangular stems of several species would furnish reliable characters so as to distinguish them from those in which the stem is nearly terete; but the author calls attention to the fact that the same stem is often not triangular in its whole length.

Among the characters derived from the stem it may be men-

[1] Cfr. SACHS: Vorlesungen über Pflanzenphysiologie 1887, p. 186.

tioned that the mestome-bundles form a different number of rows in certain species, varying from one to four as in *C. Grayii.* The rhizome shows even in its external anatomy a few characteristic differences, if we consider the stoloniferous and cespitose forms. But the internal structure gives still more and very characteristic differences, observable in the stereome, the lacunes, the endodermis, etc. As to the root, the author has observed also here a certain variation. The endodermis and the pericambium does not form a closed ring in all species, but the latter is most often interrupted by the hadrome, as described by Van Tieghem as characteristic for Xyrideæ, Eriocaulaceæ, Juncaceæ and a few other families.

The author is undoubtedly correct, when in the following chapter, where he gives an anatomical sketch of the species in question, he remarks that the characters to some extent may prove to be of specific value, but that it would be impossible from the present study to draw any conclusion as to the mutual relationship of the species described.—THEO. HOLM.

BRIEFER ARTICLES.

Cryptomitrium tenerum Austin.—Mr. O. F. Cook of Syracuse University had the kindness to send me, on my request, a specimen of the above named hepatic, which, being rather imperfectly described by its author, I have undertaken to examine thoroughly, so that the exact systematic position of this very interesting plant may with safety be established. Before going into details as to the relationship of this plant, I give a description of it, as follows:

CRYPTOMITRIUM TENERUM (Hooker) Austin.

Marchantia tenera Hooker in Kunth. Syn. plant. I. p. 45.

Duvalia tenera Gottsche: Synopsis Hepat. p. 554.

Plantae frondosae, terrestres, membranaceae, tenerae, minores, virides, arcte repentes.

Frons oblonga, repetito furcata vel monopodialiter ramosa (furca fertili brevi, altera furca solum increscente). Adsunt etiam rami steriles cum basi angustata ex apice frondis orti vel alii rami adventivi postici e costae latere orti. *Costa* pro plantae tenuitate sat crassa, angusta, in alas sensim attenuata, sub alis evanida, cellulis aequimagnis (corticalibus minoribus) aedificata, *alae* latissimae valde attenuatae, margine tenuissimo unistrato. *Stratum* aëriferum humile, cavernosum; *cavernae* amplae unistratae vacuae i. e. filis vel laminulis acces-

soriis, haud repletae, lamellis unistratis formatae. *Stomata* parum elevata, exigua, cellulis 5–6 radiatis superficialibus constantia, *poro* minimo vel fere nullo, interdum tamen majore cellulisque apice convexo-prominentibus stellaeformi. *Cellulae epidermidis* parvae, haud incrassatae.

Squamae posticae biseriatae, parvae, remotae, purpureae vel violaceae, late ovatae, varie lobatae, lobis superioribus appendiculo filiformi munitis. *Radicellae* incrassatae e basi paginaque squamarum ortae.

Inflorescentia monoica. *Androecia* flori femineo approximata, *antheridiis* in medio costae uniseriatis, saepe totam costae longitudinem occupantibus; *ostiola* conica, pallida. *Pedunculus* capitulorum ex apice costae — strato hypoporo recedente — ortus, basi apiceque nudus, longus, tenuis, bicanaliculatus, irregulariter sulcato-carinatus. *Capitula* feminea circularia, disciformia, antice leniter convexa, 5–6 costata, costae radiatae humiles papulosae, in centro capituli crassae; capitula versus marginem valde attenuata, margine ipso regulariter denseque crenata, postice plana, 5–6 locularia; *loculi* radiatim positi, capituli marginem haud attingentes, involucrati; *involucra* e margine loculorum orta, ovalia, parva, inflata, monogyna, parietibus crassis parenchymaticis, longitudinaliter fissa, labiis conniventibus quasi clausa, tempore maturitatis tenuibus apertis. *Calyptra* tenuis, basi bistrata. *Capsula* sphaerica, vix exserta, bulbo sphaerico affixa, pedunculo subnullo, operculo dehiscens, pariete tenui exannulifera, unistrata. *Elateres* longiusculi bispiri. *Sporae* brunneae, tetraëdrae, reticulatim lamellatae, dilute limbatae.

HAB.— California. Mexico (*Humboldt*).

If we compare this plant with other genera of the order of Marchantiaceæ its close affinity to *Duvalia* is undoubted; it has the same minute stomata, reduced to 5 or 6 conical cells with a very small pore in the center; in both the assimilating stratum consists of a single layer of caverns, which in Duvalia, however, have numerous secondary scales growing out of the walls and sometimes connate to the opposite wall. The postical scales in both genera are very irregularly lobed and dissected, not seldom down to the very base, so that the biseriate arrangement is somewhat obscured. The inflorescence is monoicous in both; in *Duvalia*, however, the male organs, which in Cryptomitrium stand just behind the female peduncle, spring from different branches of the plant; in both the androecia are not pedunculate and the antheridia, as in *Riccia*, are immersed in the substance of the frond; they produce small conical ostiola, which are arranged in a long row; in Duvalia they are united into a small roundish disk and surrounded by minute lanceolate scales.

The female receptacle or capitulum of both genera has a long peduncle, which springs from the end of the costa, being a continuation of the frond, of which the cavernous stratum is left behind (which in *Marchantia*, for instance, is carried up to and may be found in transverse sections of the peduncle on its antical side); in Duvalia this peduncle has but one furrow, in Cryptomitrium two; the female receptacles are very different and justify the separation of Cryptomitrium from Duvalia, being disciform in the former and almost spherical in the latter; the rays of the receptacle in Duvalia are incurved and on the postical side united into a fleshy annulus, which surrounds the end of the peduncle in form of a short vagina, while in Cryptomitrium they are stretched out and united into an uninterrupted plane and fleshy disk; in both genera, however, the involucra spring from the postical side of the substance *between* the rays, contrary to other genera, (*Grimaldia*, *Clevea*. and others) in which the rays themselves are developed into involucra.

There are no perianths and the capsules of both genera open with an operculum. Spores and elaters do not show any material differences.

There could be traced numerous other affinities and distinctions with regard to other Marchantiaceæ; but this would exceed the scope of this article and would involve me in a great many morphological and anatomical details, which I leave to the study of those who read German and are, therefore, able to understand Leitgeb's "Untersuchungen über die Lebermoose," the only scientific work on the development and anatomy of these plants which is very exhaustive, though our plant was not known to its author.— F. Stephani, *Leipzig.*

Pyrus Ioensis.— Professor A. S. Hitchcock tells me that at St. Louis Pyrus Ioensis (see American Garden, XII. 469, Aug. 1891,) is clearly distinct from *P. coronaria*. Among other differences, P. Ioensis holds its fruit longer than the other. He gives me the following note of its fruit: "Fruit about 25 mm. high and 30 mm. in diameter. Peduncle 30 mm. long, with two scars. Apple sunken at each end, where it is pubescent; color green or slightly yellowish. Lenticels rather prominent and numerous. Fruit falling October 26th."—L. H. Bailey, *Cornell University, Ithaca, N. Y.*

EDITORIAL.

An International Congress of Botanists is an exceedingly valuable thing, provided it is really what the name implies. If, however, the real botanists, whom we would delight to honor, stay at home, and we

have let loose upon us a crowd of quasi-botanists, such a class as is more apt to journey far to congresses than any other, our lines will not have fallen to us in pleasant places. The men we want to visit us are busy, very busy, and are little given to take such long trips for manifestly cosmetic purposes. It would be a phenomenal thing to secure even a fair representation of the real botanists of Europe. There will be great danger, a danger seen lurking around even so conservative a body as our American Association, of confounding a foreign label with one of distinction. The percentage of smatterers and cranks is probably as large in other countries as in the United States, and it is well known that such classes travel further and talk more profusely than any other. We will have to show our good judgment, therefore, not in indiscriminate but in proper recognition.

NOTHING would so arouse the active interest of American botanists in this venture as an announcement by the local committee that has the affair in charge, of the names of distinguished foreign botanists who have signified their intention of being present. American botanists will enthusiastically entertain their foreign brethren, and along with the grain will endure a reasonable amount of chaff; but they cannot be expected to endure all chaff. It is not to be expected that the perfunctory invitations of the committee will secure all the desired attendance. These invitations must be supplemented by those urgent private ones sent by acquaintances and correspondents. It is the latter kind that really count. The International Congress will probably be a success if every American botanist will privately urge the attendance of his foreign friends.

IF THE CONGRESS becomes really representative, its discussions will carry great weight; and any of its decisions with reference to modes of procedure will probably be recognized. If, however, it proves to be a body whose representative character may well be called in question, no such decisions should be promulgated. More important than the nomenclature questions, which, like the poor, we have always with us, are questions of uniform terminology with reference to plant structures, a uniformity that is not so much to avoid confusion of names as confusion of ideas. This will open a vast field of usefulness to the congress, provided always that it is representative, which is to say competent.

OPEN LETTERS.

Suggested by Kuntze's "Revisio Generum Plantarum."

In recent years many changes of well established names have been made solely to satisfy the law of priority, and not owing to any difference in judgment as to generic or specific rank. In some instances this has been carried so far as to abandon long established and household words for names wholly unknown and often inappropriate, because the latter were published a year earlier, or even not any earlier, but simply on the preceding page of the same book, or still logically, say, in the preceding paragraph or line.

When we have objected to calling Nymphæa *Castalia*, or Carya *Hicoria*, or Magnolia grandiflora *M. fœtida*, our mouths have been stopped by the law of priority, and our ruffled tempers have been smoothed by the assurance that all of these vexatious changes were *in the line of stability*, that it would take only a few years to get accustomed to calling Jones *Brown* and Smith *Thompson*, and after the first little inconvenience and strangeness all would settle down into blissful permanency. The mild suggestion that, owing to the different judgments of men and the zeal of future antiquarians we might be simply opening the floodgates to an increased instability, has generally been received by the innovators with bland incredulity. But, to show how the thing really works, now comes along Kuntze with his tremendous *Revisio Generum Plantarum*, and finds it necessary to make 30,000 changes in specific names before he can publish his description of species collected in a journey round the world! Alas, in obedience to the new dictum, or dictator, for he speaks *ex cathedra*, we must no longer call Jones *Brown*, and Smith *Thompson*, but must hereafter call Jones *Baker*, and Smith *Jenkins*. By the irony of fate, we are shown very clearly just how much stability some of the more recent and distressing changes are likely to have. E. g., Nymphæa becomes Leuconymphæa (1737) and Castalia is no more. In the same way Carya becomes Scoria (1808) and Hicoria is shelved. Corydalis becomes Capnodes; Dicentra, Capnorchis; Glaucinium, Mosenthina; Lepidium, Nasturtium; Claytonia, Calandria; Ionidium, Calceolaria, and Calceolaria something else; Elatine, Potamopithys; Oxalis, Acetosella; Pelargonium, Geraniospermum; Rhus, Toxicodendron, and so on *ad desperandum*. Even names which have stood more than 150 years, like Liriodendron Tulipifera and Zea Mays have to be converted into Tulipifera Liriodendron and Thalysia Mays to satisfy the ghost of some dead botanist, and the zeal of a live antiquarian.

Old debts become *outlawed* after a time, and it would simplify matters greatly to apply the same practice to old names. There seems almost no end to the changes a persistent rummaging of old literature can bring to light, and we may be certain it will not end with Kuntze. For one, I most devoutly wish the strict law of priority were at the bottom of the sea. It does seem that it would be better to study nature more and parchments less. But the proof of a pudding is said to be the eating, and this closely printed book of a thousand pages is commended to the digestion of Messieurs, the systematists.— ERWIN F. SMITH, *Washington, D. C.*

NOTES AND NEWS.

A "CONSPECTUS FLORÆ AFRICÆ" is promised by Messrs. Durand of Brussels, and Schinz of Zürich.

THE ENTIRE EDITION of the *Proceedings* of the Society for the Promotion of Agricultural Science for 1891, which was ready for mailing, was burned in the fire at Columbus, Ohio, January 26th. Re-printing the edition has already begun.

MR. C. W. SEELYE, of Rochester, N. Y., has published "A list of the indigenous ferns of the vicinity of Rochester, with notes," a reprint from Proceedings of the Rochester Academy of Science. Of the 53 species of ferns credited to New York state in the Torrey club list, the flora of the vicinity of Rochester contains 35.

A LONG and able article on "Climate and plants" was read by Professor L. H. Pammel before the Iowa Horticultural Society at its meeting in January, 1891, and is published in the Monthly Review of the Iowa Weather Service for October last. It treats the subject from many sides, and contains a wealth of citations.

AMONG the recent bulletins from the experiment stations is one on "Some fungous diseases of the grape" by F. Lamson-Scribner, and one on "Electricity in agriculture" by Clarence D. Warner. The latter has also been published in *Science* for January 15, and is to be commended to those curious in such matters for the utter lack of logical basis for its conclusions.

THE ANNALS OF SCOTTISH NATURAL HISTORY issues its first number with the new year. It is a successor to the *Scottish Naturalist*, and resembles it in form and matter, but is much improved in both, and contains new departments. It is devoted to developing a knowledge of the flora and fauna of Scotland, both recent and fossil. The present number contains 84 pages and two excellent plates. It is a quarterly.

THE UNIVERSITY OF INDIANA has just purchased the entire herbarium of Mr. F. H. Horsford, of Charlotte, Vermont. The collection is very complete in its display of New England and Canadian plants, besides that general assortment of plants which comes into the hands of a collector. The collection is remarkable for the beauty of its specimens, many of them being the handiwork of Mr. Pringle, with whom Mr. Horsford has been so long associated.

THE FOLLOWING botanical papers were presented before the Iowa Academy of Sciences at its December meeting: Some experiments for the purpose of determining the active principles of bread-making, by Miss Minnie Howe; The action of disinfectants on nutrient media, by W. B. Niles; Slime molds of Iowa, by T. H. McBride; Bacteria of milk, Report of committtee on state flora, Phenological notes, and Experiments in prevention of corn smut, by L. H. Pammel.

IN AN EDITORIAL upon the Royal Gardens, Kew, *The Gardener's Chronicle* (Jan.2) gives an account of its rapid and splendid development since its establishment in 1841, and suggests needed extensions in two directions, viz: a staff of workers to investigate plant diseases, and another for the systematic and coöperative study of the minute anatomy of plants. The suggestion is surely a timely one. It is per-

fectly possible for this great establishment, with its unrivaled opportunities, to become "the center of energy" in many departments.

PROFESSOR WITTROCK gives in a recent paper[1] a very interesting account of the life-history of *Linaria Reverchoni*, a new species collected in Spain. The cotyledons, two or even and quite frequently three, are lanceolate-spathulate, suddenly attenuated towards the apex, which thereby forms like a terminal lobe. There is a long hypocotyl, from the base of which adventitious buds develop and soon grow out, while the main shoot finishes its growth at a very early stage and without any development of either flowers or vegetative buds. The propagation of this species is therefore dependent upon the formation of these adventitious shoots, which are terminated by an inflorescence, besides which they may also branch and often carry a few secondary inflorescences.—T. H.

AGRICULTURAL SCIENCE, founded by Professor C. S. Plumb five years ago, and ably conducted by him up to the close of last year, has been transferred to Professor Wm. Frear of the State College, Pa., who will in future assume the financial and editorial management. Professor Frear has secured the coöperation of sixteen prominent investigators, who will give editorial assistance in the several departments of agricultural activity. Only one of these, Professor F. L. Scribner, is a botanist, and to him is assigned the duty of looking after "botany and mycology," according to the prospectus. The "and" in that triplet of words is a pretty sure indication that the management is not especially familiar with the several departments of botany, and probably does not appreciate its present scope or its importance as a science underlying a large proportion of agricultural operations. The journal has occupied an important place in the past; and it deserves hearty support under the new relations.

PROFESSOR LESTER F. WARD's paper on "Principles and methods of geologic correlations by means of fossil plants," read before Section E of the A. A. A. S., Washington meeting, is printed in the *American Geologist* (Jan.). Of course it is a strong putting forward of the claims of paleobotany by one of its most competent exponents; but a point of special interest to botanists is the retort made by the author to the general botanical accusation of paucity of material and uncertainty of results. Stating that paleobotany has added not a little to our knowledge of botany proper, the author proceeds to say: "For example, it is the habit of botanists to figure leaves so carelessly that the paleobotanist is unable to tell the genera to which they belong. This is chiefly due to the fact that they ignore, as a rule, the exact nervation of leaves, and are content to figure them almost from the standpoint of the artist, merely for the sake of the effect. Paleobotany has taught the botanists that the nervation of leaves is important, and that wherever possible it should be carefully figured. We are indebted to fossil plants for the discovery that nervation in leaves is of generic rank, whereas form, upon which the botanist chiefly relies, is usually only of specific rank." Botanists must confess to myriads of figures of leaves, in which the nervation is merely conventional.

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[1] *De Linaria Reverchoni* n. sp. observations morphologicae et biologicae. Acta horti Bergiani, vol. I. no. 4, Stockholm, 1891.

BOTANICAL GAZETTE

MARCH, 1892.

Flowers and insects. VII.

CHARLES ROBERTSON.

MARTYNIA PROBOSCIDEA Glox.—I know of but one station for this plant—on the banks of the Macoupin Creek, where it appears to be indigenous.

The pale bluish corolla measures about 5½ cm. in length, its tube about 3½ cm. The tube within is finely spotted with bluish; on the lower wall there are about three orange lines leading from the narrow part of the tube and expanding in a large spot on the lower lip. The throat above is spotted with reddish, on the sides with bluish. The middle lobe of the lower lip is streaked with bluish and is straight, while the others are reflexed.

The anthers lie against the upper wall in the median line, with their cells directed longitudinally. The stigma is in advance of them and closes when touched, as observed by Delpino.[1] The narrow part of the tube is about 8 mm. long which with other characters of the flower seems to indicate an adaptation to long-tongued bees. I have found the flowers in bloom from Aug. 19 to Sept. 14. Sept. 3, 1890, I saw *Bombus americanorum* F. ☿ sucking the honey, its thorax being streaked with pollen.

At Metropolis, Ill., Aug. 14, Mr. C. A. Hart found it visited by *Xenoglossa brevicornis* Rab. (MS.) ♂ ♀.

DIANTHERA AMERICANA L.—The plant is rather common in shallow water of streams, the stems rising from 3 to 9 dm. and bearing small clusters of purplish flowers.

The flowers are proterandrous. The two-lobed upper lip stands erect and is strongly marked with purple. The lower lip is formed by three widely divergent lobes, which are white, the middle one with much purple.

[1]Sugli apparecchi delle fecondazione nelle piante antocarpee, 1867.

A straight stamen stands on each side. The anther cells are widely separated; one stands vertically, facing the corresponding cell of the other stamen; the other, the outer one, is placed horizontally and has its dehiscent surface turned upwards. The stamens stand so erect that at first I wondered how the bee would come in contact with them. I also wondered why the anther cells are at right angles to each other. As a rule, only two flowers are in bloom in the umbel-like cluster at a time. The three lobes of the lower lip, which we have observed are strongly divergent, are curved upward, so that it is most convenient for the bee to enter between the middle and one of the lateral lobes. In this way it is apt to brush the vertical face of the inner anther-cell. To reach the other flower, the bee crawls directly upwards and approaches it from above. In crawling up out of one flower and down into the other the bee is likely to touch the horizontal faces of the outer anther-cells.

The corolla tube is about 5 mm. long, so that the nectar can be obtained by tongues of medium length. The flower is evidently adapted to bees, but is often visited by flies and butterflies. I have found it in bloom from June 23 to Aug. 24. On July 5 and 9 I observed the following visitors:—

Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, s., ab.; (2) Bombus virginicus Oliv. ☿, s.; (3) Melissodes palustris Rob. ♂, s., ab.; (4) M. bimaculata Lep. ♂♀, s., ab.; (5) Ceratina dupla Say ♀, s.; (6) Epeolus lunatus Say ♂♀, s.; *Andrenidae:* (7) Agapostemon nigricornis F. ♀, s.; (8) A. radiatus Say ♂♀, s.; (9) Augochlora pura Say ♀, s. and c. p., ab.; (10) Halictus lerouxii Lep. ♂♀, s., ab.; (11) H. ligatus Say ♂♀, s.; (12) H. fasciatus Nyl. ♂♀, s.; (13) H. pilosus Sm. ♀, c. p.; (14) H. confusus Sm. ♀, c. p., ab.

Diptera—*Syrphidae:* (15) Allograpta obliqua Say, f. p.; (16) Mesograpta marginata Say, f. p.; (17) Sphærophoria cylindrica Say, f. p.; (18) Eristalis tenax L., s. and f. p.; (19) Helophilus laetus Lw., f. p.; (20) Tropidia quadrata Say, s., freq.; (21) Syritta pipiens L., f. p.

Lepidoptera — *Rhopalocera:* (22) Pieris rapae L.; (23) Phyciodes nycteis D.-H.; (24) Lycaena pseudargiolus B.-L.; (25) Pamphila metacomet Harr.; (26) Pholisora catullus F.—all s.

VERBENA STRICTA Vent.—The plant is quite common. The stem rises from 5 to 10 dm. and bears numerous erect spikes of blue flowers.

The corolla tube rises directly upward, bending outward above and joining the vertically expanded border, which is five-lobed and somewhat two-lipped, expanding from 6 to 12 mm. The tube is about 5 mm. long, is quite narrow and is closed at the mouth by a dense circle of hairs.

The flowers appear homogamous and I see nothing to prevent an insect's proboscis from carrying pollen from the anther back to the stigma of the same flower, though if the proboscis is thoroughly dusted with pollen from another flower, cross-pollination may be more likely.

I have found the flowers in bloom from June 15 to Sept. 16. On nine days, July 9—Aug. 7, I observed the following insects sucking the nectar:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿; (2) Bombus virginicus Oliv. ♂; (3) Melissodes aurigenia Cr. ♂; (4) M. perplexa Cr. ♂♀, ab.; (5) Ceratina dupla Say ♀; (6) Epeolus mercatus F. ♂; *Sphecidae*: (7) Ammophila procera Klug.

Lepidoptera—*Rhopalocera*: (8) Pieris protodice B.-L.; (9) P. rapae L.; (10) Danais archippus F.; (11) Pamphila peckius Kby.; (12) P. cernes B.-L.; (13) Pholisora catullus F.; (14) P. hayhurstii Edw.; (15) Eudamus tityrus F.

Diptera—*Bombylidae*: (16) Exoprosopa fasciata Mcq. ab.; *Conopidae*: (17) Stylogaster neglecta Will.; *Syrphidae*: (18) Eristalis tenax L.

VERBENA HASTATA L.—This plant is less abundant than the last, grows taller and bears small spikes and smaller blue flowers.

The border is 3 to 5 mm. across and the tube 3 or 4 mm. in length.

I have found it in bloom from July 12 to Sep. 23. On 8 days, July 12—Sept. 7, the following insects were observed visiting the flowers for nectar:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, ab.; (2) Bombus americanorum F. ♂; (3) B. separatus Cr. ☿; (4) Epeolus remigatus F.; *Andrenidae*: (5) Agapostemon radiatus Say ♂; (6) Augochlora pura Say ♂, ab.; (7) Halictus lerouxii Lep. ♂♀; (8) H. fasciatus Nyl. ♂, ab.; (9) H. zephyrus Sm. ♂; *Sphecidae*: (10) Ammophila pictipennis Walsh.

Lepidoptera—*Rhopalocera*: (11) Pieris protodice B.-L.; (12) Pholisora catullus F.; (13) Eudamus tityrus F.

Diptera—*Bombylidae*: (14) Systoechus vulgaris Lw.; (15) Exoprosopa fasciata Mcq., ab.

VERBENA URTICAEFOLIA L.—The flowers are white, much smaller than in the preceding, and are arranged in long loose spikes. Blooms from June 29 to Sept 7, or later. On 8 days July 11—Aug. 29, I observed the following insects, all sucking:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿; (2) Bombus americanorum F. ♂☿; *Andrenidae*: (3) Augochlora pura Say ♂; (4) Halictus ligatus Say ♀; (5) H. confusus Sm. ♀.

Diptera—*Empidae*: (6) Empis clausa Rob. (MS.); *Conopidae*: (7) Stylogaster neglecta Will.; *Syrphidae*: (8) Mesograpta geminata Say; (9) Sphaerophoria cylindrica Say; (10) Syritta pipiens L.

Lepidoptera—*Rhopalocera*: (11) Pieris protodice B.-L.; (12) P. rapae L.

PHRYMA LEPTOSTACHYA L.—The plant grows in damp woods and is not very common. I have found it in bloom from July 10 to Sept. 3. The stem rises about 6 dm. high and bears several branches terminating in slender spikes, which commonly show but two flowers open at a time.

The flower and its three-lobed lower lip project horizontally, the short, slightly notched upper lip diverging in an upward direction. The corolla is white, tinged with pinkish, the upper lip being almost entirely pink. It measures 8 mm. in length, its tube 5 mm., the lower lip 4 mm. in width. The lower wall of the corolla is strongly infolded forming a sort of palate which presents on each side a ridge provided with numerous stiff hairs. This structure narrows the entrance so as to exclude short tongues and to require long tongues to touch the anthers and stigma. Small bees can force their heads into the tubes by forcing down the palate. The flowers are strongly proterandrous, and are visited by *Augochlora pura*, Say ♂.

PHYTOLACCA DECANDRA L.—The stems of this common plant rise 2 m. or more, are much branched and bear numerous racemes of small whitish flowers. The five ovate, white sepals are incurved but expand so that the flower measures about 5 mm. across.

The flowers are proterandrous with a homogamous stage. Cross-fertilization between flowers of the same or of distinct plants may occur, and even self-pollination may occur by in-

sect aid. In absence of insects spontaneous self-fertilization may readily take place.[1]

The nectar is exposed. The flowers are visited by short-tongued Hymenoptera and Diptera, especially species of Halictus. I have found the plant in bloom from June 14 to Oct. 15. On July 17 and 23 I observed the following visitors:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, s.; *Andrenidae*: (2) Halictus ligatus Say ♂, s.; (3) H. fasciatus Nyl. ♂, s.; (4) H. confusus Sm. ♀, s. and c. p., ab.; (5) H. zephyrus Sm. ♀, s.; (6) H. stultus Cr. ♂♀, s. and c. p., ab.; *Vespidae*: (7) Polistes metricus Say, s.; *Pompilidae*: (8) Priocnemis fulvicornis Cr., s.

Diptera—*Empidae*: (9) Empis clausa Rob. (MS.) s.; *Syrphidae*: (10) Mesograpta geminata Say, s.; (11) Syritta pipiens L., s., ab.; *Tachinidae*: (12) Jurinia apicifera Wlk. s.

HYPOXIS ERECTA L.—This plant is quite common in prairies and woods. The scapes, generally one to each plant, rise one or two dm., usually exposing only one open flower at a time. The flowers are yellow, the lanceolate divisions expanding horizontally from 12 to 25 mm. The six stamens are strongly divergent, the stigma occupying the centre of the circle, so that in absence of insects self-pollination cannot occur, unless it happens after the flowers close.

As a rule, insect visits result in cross-fertilization between distinct plants, but may also result in self-pollination.

The flowers are visited only for pollen, and depend especially upon Halictus. I have found them in bloom from April 28 to June 12. May 19 and 22 I observed as visitors:—

Hymenoptera—*Apidae*: (1) Ceratina dupla Say ♀, ab.; *Andrenidae*: (2) Augochlora pura Say ♀, ab.; (3) Halictus pectoralis Sm. ♀; (4) H. coriaceus Sm. ♀; (5) H. ligatus Say ♀; (6) H. cressonii Rob. ♀; (7) H. stultus Cr. ♀; (8) H. tegularis Rob. ♀; (9) H. anomalus Rob. ♀—all collecting pollen.

Diptera—*Syrphidae*: (10) Mesograpta geminata Say; (11) Sphaerophoria cylindrica Say; *Anthomyidae*: (12) Chortophila sp.

Coleoptera—*Buprestidae*: (13) Acmaeodera culta Web.—all feeding on pollen.

ERYTHRONIUM ALBIDUM Nutt.—This is one of the first flowers of spring, and is quite common. The flower bud ap-

[1]According to Meehan. Proc. Acad. Nat. Sci. Phil. 1890, 272, the flower is spontaneously self-fertilized before opening.

pears with a pair of leaves and rises on a scape only a few centimetres above the ground. Owing to a bend in the scape, the flower looks outward and downward, or directly downward. The divisions of the perianth are white, tinged with purplish exteriorly, and marked with yellow at the base within, especially the three petals, which hold nectar on the bases of their claws. At base the divisions are closely approximated, forming a tube about 15 mm. in length, and making the nectar hard to reach except by insects with long tongues; beyond they are directed outward and downward, or may be expanded horizontally so that the flower measures 65 mm. across, or they may be so strongly reflexed that their tips meet, as in the case of plants growing in rich bottom soil.

The anthers of the three outer, shorter stamens dehisce first. At this time, if an insect come with pollen, it will leave some upon the stigma, which is somewhat in advance of the dehiscent anthers; otherwise, it may effect self-pollination. Cross-fertilization may readily occur at any time, but when the inner anthers dehisce, they may easily leave some of their pollen upon the stigma, since they usually surpass the stigma a little. Accordingly, in absence of insects, I think that self-pollination commonly occurs.

The pendulous position of the flower has the effect of restricting the visitors almost exclusively to bees, since they can readily cling to the stamens and style. The first flowers, which appear before flower insects become common, are visited almost exclusively by hive-bees.

For the attention of insects the plant is in competition with Anemonella thalictroides, Isopyrum biternatum, Sanguinaria Canadensis, Viola palmata, Claytonia Virginica and Dentaria laciniata. Competition with Claytonia is most severe; I have found it difficult to collect the visitors of Erythronium until afternoon, after the flowers of the Claytonia had closed.

I have found the plant in bloom from Mar. 17 to Apr. 22. On 13 days, between Apr. 7 and 19, I saw the flowers visited by:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, s. and c. p., ab.; (2) Bombus virginicus Oliv. ♀, s., one; (3) Ceratina dupla Say ♂, s.; (4) Osmia atriventris Cr. ♂, s., ab.; (5) O. albiventris Cr. ♂♀, s., ab.; (6) O. lignaria Say ♂, s.; (7) O. latitarsis Cr. ♂, s.; (8) Nomada luteola Lep. ♂, s., ab.; *Andrenidae*: (9) Andrena bicolor F. ♂♀, s., ab.; (10) A. sayi Rob. ♂, s.; (11) A.

erythronii Rob. ♂♀, s. and c. p., ab.; (12) A. mariae Rob. ♀, s.; (13) Halictus lerouxii Lep. ♀, s.; (14) H. fasciatus Nyl. ♀, s.; (15) H. confusus Sm. ♀, s.; (16) Colletes inaequalis Say ♂, s. ab.

Lepidoptera—*Rhopalocera*: (17) Pieris rapae L., s.; (18) Colias philodice Godt., s.; (19) Nisoniades juvenalis F., s.

Diptera—*Bombylidae*: (20) Bombylius fratellus Wd., s., one; *Syrphidae*: (21) Brachypalpus frontosus Lw., f. p., one; *Muscidae*: (22) Lucilia cornicina F., s., not touching stigma.

TRADESCANTIA VIRGINICA L. (smooth form).—The plant is smooth and glaucous with linear leaves, the stems rising 3 to 6 dm. and bearing from one to three umbel-like clusters of flowers, each umbel in turn with from 1 to 5 open flowers. The flowers are blue, expanding 3 or 4 cm., but retaining a shallow, bell-shaped form. The stigma is widely separated from the anthers and somewhat surpasses them. Spontaneous self-pollination is hardly probable while the flower is open. Cross-pollination between flowers of the same plant may occur, but owing to the small number of flowers exposed on one plant at a time, cross-pollination between flowers of distinct plants is much more probable.

The flowers are specially adapted to female bees, and other insects in search of pollen. The hairs on the stamens are foot-holds for the use of bees in collecting pollen.

The plant is in strong competition with Rosa humilis for the attention of pollen-visitors, Tradescantia having the advantage of abundance and Rosa of conspicuousness. But they avoid competition to some extent by dividing the visitors between them, Rosa taking the large ones and Tradescantia the small ones.

I have found it in bloom from May 22 to July 30. The following list of visitors was observed on June 4, 5 and 12:—

Hymenoptera—*Apidae*: (1) Bombus pennsylvanicus DeG. ♀; (2) Bombus separatus Cr. ♀; (3) Synhalonia speciosa Cr. ♀; (4) Ceratina dupla Say ♀; *Andrenidae*: (5) Agapostemon nigricornis F. ♀; (6) Halictus pruinosus Rob. ♀—all c. p.

Diptera—*Syrphidae*: (7) Syrphus ribesii L.; (8) S. americanus Wd.; (9) Allograpta obliqua Say; (10) Mesograpta marginata Say; (11) Sphaerophoria cylindrica Say; (12) Tropidia mamillata Lw.

Coleoptera—*Curculionidae*: (13) Stethobaris sp.—all f. p.

Carlinville, Ill.

Evolution in methods of pollination.

ALICE CARTER.

[*Concluded from p. 46.*]

Among animals, the phase of natural selection known as sexual selection comes to the front in the production of many things which we call beautiful or curious; such as the gorgeous colors of male birds and butterflies, the horns of beetles and reindeer, the tusks of boars and elephants, the chirping of crickets and the songs of birds. (It is noteworthy, here as elsewhere, how similar organs have been independently developed for similar ends in most widely different classes of organisms.) The higher plants, however, because of their fixed position, are removed from the power and influence of sexual selection, and its offices of the production of attractive qualities are performed for them in a most remarkable way by the agency of insects. Insect selection takes the place of natural selection, and to it we largely owe the fragrance, color and form of our beautiful flowers.[1] This is one side of the picture ; the animals themselves are the other. Side by side with the flowers they frequent they have themselves been changed, their proboscides lengthening with the flower tubes, their bodies becoming better adapted to the forms of the blossoms and to the carrying of the pollen, their wits sharpened to find the means of getting at the hidden honey with the least possible loss of time and strength, and to read quickly the posters hung out by the plants, which enable the more intelligent customers to distinguish one kind of flower from another, and show them when the time for visiting is reached or passed. So now, instead of the primeval cockroach-like creatures, there are insects as varied and wonderful in form and structure as the flowers they frequent.

This subject is full of interest, and since the time of Darwin has been widely studied, but the knowledge accumulated should be put into form convenient for every day use. If, as we believe, flowers have been produced by a gradual adapta-

[1] The variations — the presuppositions of progress — are, of course, inherent in the plant nature, produced by causes not yet fully understood. The insects have simply chosen and therefore perpetuated those best adapted to their own needs which must also of necessity be those which are advantageous or at least not injurious, to the plants themselves.

tion to the reciprocal wants of plants and their visitors, from fructifications essentially like the spore-bearing spikes of the heterosporous Equisetums of which geologists write, this ought to be known by every student, and everyone should be able to see from the manual that, in each order, the method of fertilization is to a certain extent an index of the degree of specialization of the reproductive apparatus, the most important part of the plant. In many orders there is a most beautiful transition from anemophilous (usually polygamous, monœcious or diœcious) species through almost exclusively self-fertilized hemaphrodite ones to those that are incapable of self-fertilization. For example, in the Ranunculaceae, in the gradation from the wind-blown inflorescences of polygamous Thalictrums to the inconspicuous, almost exclusively self-fertilized flowers of Myosurus minimus; from this to the genus Ranunculus (whose small-flowered species, such as R. abortivus and R. sceleratus closely resemble Myosurus in the arrangement of the carpels and stamens, while the large species, R. repens, R. bulbosus, etc., are abundantly visited and crossed); from Ranunculus to Aquilegia, and from Aquilegia to Delphinium and Aconitum, there is a suggestion in the compass of a single order of the probable historical development of irregular, brightly colored, greatly specialized, insect-fertilized forms from the grass-like or pine-like, spore-bearing stalks of the ancestors of our dicotyledons.

At a certain stage of development, these changing plants will be perfectly adapted to neither wind nor insect fertilization; then those individuals whose stamens and pistils are borne in adjacent clusters, or better yet, within the same bracts, will be most sure of ripening seed. Clavaud says: "There does not exist a diœcious plant which cannot exceptionally offer the two sexes upon the same stalk." The common occurrence of stamens in the pistillate, and of pistils in the staminate clusters of trees and other plants described as monœcious or diœcious, is known to every observer. Such variations, sometimes perhaps preserving the lives of the plants which possess them, will be passed on to their descendants. In other words, hermaphrodite flowers may have arisen from unisexual ones, as unisexual ones are now actually being produced from hermaphrodite (e. g. in many genera of Labiatæ, in some species of Silene). So it comes to pass that though the majority of wind-fertilized plants have the sexes

separated, almost all entomophilous ones have stamens and pistils in the same flowers. Müller therefore considers diclinism to have been the original condition of phanerogams, from which hermaphroditism has been developed by natural selection. Darwin takes exactly the opposite view. But it hardly seems necessary to adopt either exclusively, for both hermaphrodite and unisexual forms are common among the lower plants. Why cannot both forms have been transmitted from the pteridophyte-like ancestors of phanerogams? Diclinism and bisexualism may be collateral branches, one not necessarily older than the other, though in many individual cases it is evident that one has been, or is being derived from the other.

When a plant has become adapted either to self or insect fertilization there is no longer necessity for the production of vastly greater quantities of pollen than can be used, for either method is more sure than dependence upon wind agency. Frugal nature then turns the energy no longer needed for spore formation into another channel. Some of the stamens, losing their power to produce pollen, may become exclusively organs of attraction. Numerous transition stages are represented in the genera Thalictrum, Clematis, Nymphaea, etc. The origin of brighter color may be like that of nectar (BOTANICAL GAZETTE, vol. XV, p. 177) a result of the unusually active life processes in connection with the strong current necessary to supply the ovules and anthers with materials required for the development of their richly fed spores. The same principle is at work which Wallace and others have shown to prevail among animals, whose highly colored organs are, as a rule, those which are most continually exercised; e. g. the wings of butterflies, the wings, tails and beaks of birds, etc.

Again, the rule that among animals a great number of similar segments is a mark of low organization, seems to hold good here. Contrast the numerous stamens and pistils and the variable number of petals or sepals of water lilies, buttercups and anemones with the small and always constant number characteristic of the aristocratic families, the Violaceæ, Compositæ, Labiatæ and Scrophulariaceæ. This decrease in the number of the floral organs is often accompanied by further specialization by the union of their individual members to secure still better protection of the pollen, honey and ovules and better adaptation to the agents of pollination.

When cross-fertilization by means of insects has become assured, the color, time of flowering, fragrance, the length of the corolla tube, the form and position of the petals and sepals, all have reference to time of flight and character of the especially invited guests. Every hair has a meaning. Every curve is an adaptation. The power of self-fertilization, at first indispensable, may become useless. A struggle for existence arises between the two methods and the least efficient goes to the ground. So cross-fertilization is, as a rule, alone possible among the majority of orchids, some Compositæ, some species of Salvia, Aconitum, Corydalis, Dianthus, Malva and others. Many changes, progressive and retrogressive, are still going on. It is known that the honey of more than one hundred and thirty-two flowers can be plundered from outside without the touching of the stamens or stigma. In these cases at least, perfection has, not been reached; but the wonderful contrivances to prevent the entrance of useless guests, such as hairs on the calyx, corolla or stamens, slipperiness of the corolla, a pendent position of its tube, or the accumulation in the petals of matters offensive to insects, show that some species are on the high-road to it.

So much for flowers; but there are weeds, hundreds of them, widespread and homely. Many, perhaps all, of those which have the rudiments of calyx and corolla are degraded forms, descendents of species once fertilized by insects, but which, because of the extinction of the particular ones on which they either depend, or because they have spread into regions where these insects are not, or because thrown into the shade by the superior attractions of their neighbors, have been obliged to resort again to wind agency (Plantago?), or to adapt themselves to almost exclusive self-fertilization (Veronica hederæfolia). In either case there is no longer need of attractive organs and the petals have accordingly been reduced. The evil effects of continued self-fertilization may have had a share in this result; but probably not to a great extent, for such effects will be largely counteracted by the wide dissemination so characteristic of weeds, by which these low forms are exposes to great variation of climatic conditions. The loss is then of beauty, not of strength. Change of environment seems often to have as beneficial results as cross-fertilization in the stimulation of the life processes and the production of varieties. The degradation here, as elsewhere, is only a peculiar form of adaptation.

The theory that, by whatever means gained (by the crossing of individuals if possible, if not by self-pollination), the great object of plant-life is the production of seed, the continuance of its species, receives further support by the presence in many of the forms, most beautifully adapted to the visits of insects, of cleistogamic flowers. These are minute, never-opening flowers whose stamens produce very little pollen (from 100 to 400 grains in contrast to the 243,600 of Leontodon or the 3,654,000 of Peony), but the anthers are in close contact with the stigma, none of the pollen is wasted and the inevitable self-fertilization causes the ripening of seed enough to secure the the existence of the species, if for any reason the more conspicuous flowers are not visited. Kuhn enumerates 44 genera which have flowers of this kind; Darwin adds 12 (Viola, Impatiens, Lespedeza, Specularia, Campanula Lathyrus, etc.) May it be this small form which alone survives in some degraded species?

Such study has led me to many delightful hours spent in watching the visits of insects to flowers, with, for one result, great respect for Darwin's famous aphorism, "nature abhors perpetual self-fertilization." For though I waited a long time often, sometimes for days together, to "win the secret of some weed's plain heart," the flower lover was almost sure to come at last in the form of buzzing bombuses for the two species of Monotropa, a tiny fly for the little shore pin weed (Lechea thymifolia), clumsy bugs for the honeyless, dull-colored purple trillium (Trillium erectum), pollen eating bees and flies for the homely ragweed (Ambrosia artemisiæfolia.) During the last spring, summer, and autumn I caught a thousand insects on one hundred and forty-three species of plants (one of a kind on each). One hundred and thirty-one of these flowers are visited by Hymenoptera, fifty-seven by Lepidoptera, sixty-two by Diptera, seven by the ruby-throated humming bird. I shall not soon forget the first sight of a humming bird draining dry the nectar cups of the columbine (Aquilegia Canadensis); nor the daily visits which he afterwards made to the trumpet honeysuckle, trumpet creeper, fraxinella, Petunia, Lunaria, Rhododendron, or Rhodora; nor the silent watching in the evening for the ghost-like, dusky-winged humming bird moth, whose capture is as memorable as that of a boy's first six-pound salmon; nor the dark evening when a valiant sweep of the net over the

Japanese honeysuckle captured a supposed humming bird moth which proved to be only a June bug. The beautiful clear-winged moth (Sesia), whose first visit to the Azalea of the botanic garden was so sudden and brief that after long waiting vainly for his return I almost concluded that he had been the delusion of an excited imagination, afterwards proved himself a capturable reality and we enjoyed the further acquaintance with his family through their visits to Lunaria, Hydrophyllum, Dictamnus, Syringa, and Vinca. The memory of the gorgeous red butterfly which twice visited the smooth sumach (Rhus glabra L.), eluding our nets both times never again to appear notwithstanding our patient waiting and the reward offered for his arrest, will haunt me through the winter months and until the shade of one of his descendants joins the full ranks of those who met death on the sumach field.

Botany and zoölogy at the start are one, but when the debatable ground occupied by organisms neither animal nor vegetable is passed, each has a clear country until paths cross again in this region of reciprocal plant and animal selection. If the descent theory is true, a natural system of classification which shall show true relationship is, to some extent, possible. Such a classification has been largely adopted for the lower plants, and it will come for all. Then the standard manual of botany will no longer separate what nature has joined together; the gymnosperms will not stand between the sister classes of angiosperms, nor gamopetalous between the polypetalous and apetalous exogens. The relationship which all acknowledge will be clearly shown. The arrangement of species in each order will be a story in brief of the development of the order itself, the means of fertilization being an important factor of the determination of the comparative degree of specialization of each species. Then too we shall do away with the undignified jump from phanerogams to cryptogams, using instead the natural ladder which has been stretched between them, the gymnosperms, whose life history is in some respects so like that of pteridophytes, in others so like that of close-ovaried plants that it is hard, impossible indeed, to say to which they are most closely related. Our classification will follow the teachings of geology, histology, embryology, and common sense, and, standing on the vantage ground of a manual founded on the brotherhood

of plants, we can look over the broad battlefield of biology, and see the vast territories which have been conquered, then relinquished in turn by mosses and fungi, pteridophytes, cone-bearing plants, endogens, apetalous and polypetalous exogens, and now are largely held by today's victors, the gamopetalous dicotyledons. We can see how the hardy pines have fought stubbornly for centuries, yielding ground only inch by inch to the endogens, the secret of whose final victory was that, Niobe-like, they protected their children though perishing themselves. We can see too how these children have been driven to the marshes, windswept plains, and cold mountain hills by the onslaughts of their more completely armed younger brothers, who, leagued with the great insect kingdom, are carrying all before them.

That will be a view well worth looking at and the sooner we begin the climb to the high ground, the better. The botany of the past is a most vital part of the botany of today. Zoölogy must join hands with us. We are dependent on each other. Distribution, genealogy, and environment will enter largely into the manuals of the future. Then the touch of nature which makes the whole world kin will be added to the long Latin names and mechanical descriptions.

[The foregoing paper was prepared at Mt. Holyoke Seminary and College, S. Hadley, Mass.]

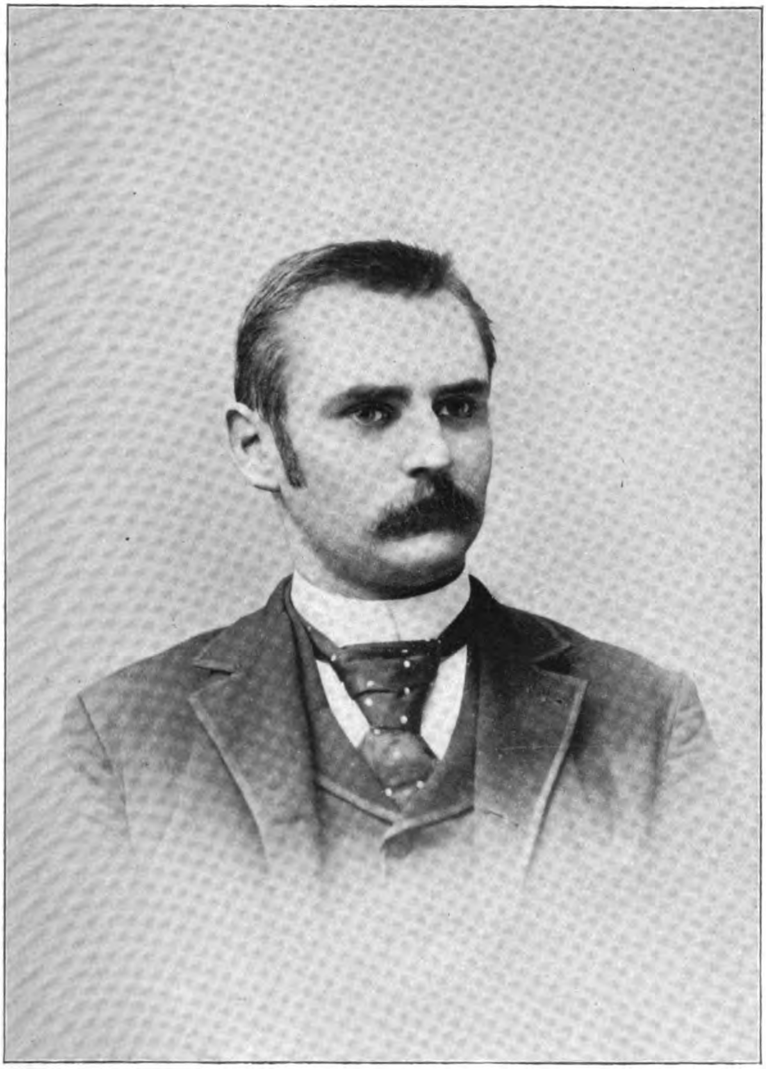
Ithaca, N. Y.

F. W. Anderson, Sc. D.

F. D. KELSEY.

(WITH PORTRAIT.)

This rising young botanist died in New York city on Dec. 22, 1891 from an abcess on the brain. He was especially known as an independent and indefatigable worker upon our Montana flora. Gone is he, no more to roam with me our Montana plains, no more to climb these mountains, no more to sit beside me in my study gazing through my microscope to discover Nature's secrets, no more to use his skilful pencil in catching upon paper the singular beauties of plant structure; gone while we are mutually planning for many more years of service together in our beloved science; gone, adding one more to the mysteries of divine providence which so often removes those that seem nidispensable.



F. W. ANDERSON.

He was born at Wisbech, Eng., June 22, 1866. In 1881 the family removed to Chicago and in 1883 he came to Montana and began his brief but brilliant career in the study of the Montana flora. In 1888 he met at Great Falls, Montana, Hon. N. J. Colman, then United States Commissioner of Agriculture. At the same time also he met the then editor of the *American Agriculturist*, the Hon. Mr. Martin, who became so attached to him that the love became as a father for a son. From this time, Mr. Anderson's life was spent in Washington, at Newfield, N. J., with Mr. J. B. Ellis, or at New York at work upon the *Agriculturist*. He was beginning to publish botanical articles quite largely and venture upon revisions and description of new species.

Mr. Anderson was an example of what can be accomplished by a man of one idea. From earliest childhood he manifested a liking for scientific pursuits. For the love of botany he surrendered in later years all thought of ease, wealth or comfort. It was heaven for him to botanize; woe was it for him to be forced to do anything else.

His honored father who survives him is a clergyman, and, like all clergymen, knows what a perplexing problem it often is to make the unknown "*x*" in the yearly equation a plus quantity. Of course, his son Fred was too much of a man to allow himself to be a burden upon the struggling father. Hence he often endured poverty rather than give up his botanical investigations.

His energy was intense, and in the freedom of my intimate relationship with him I dubbed him my "night owl"; many a time forcing him to rest long before he himself would have surrendered to sleep.

The College of Montana at Deer Lodge in June, 1890, conferred upon him the degree of Doctor of Science, in acknowledgement of his valuable services in investigating the flora of our state. This was an honor of which he knew nothing until it was thrust upon him.

The agricultural department at Washington, through Mr. Galloway and Mr. Martin, put him at one time to active service at Washington where he remained until he entered the service of Mr. J. B. Ellis, the distinguished mycologist, of whom Mr. Anderson published a biographical sketch in the GAZETTE for October, 1890. He was engaged while at Newfield in making the microscopical drawings for Mr. Ellis for

his forthcoming work on the "North American Pyrenomycetes." Upon completing his work for Mr. Ellis he was engaged upon the editorial force of the *American Agriculturist* at New York. Upon taking up his permanent residence at New York, he was elected to membership in the Torrey Botanical Club whose meetings were to him a constant delight. At this time he published, jointly with myself, a pamphlet entitled: "Common and Conspicuous Algae of Montana." This was a reprint from the Bulletin of the Torrey Botanical Club.

He began his botanical publications by sending to the BOTANICAL GAZETTE short field notes and observations from Montana, and later published observations upon our Montana fungi. His articles have most of them been short and crisp, giving promise of far greater effort in the near future. He was especially skillful in drawing and was at the time of his death engaged upon drawings for Mrs. E. G. Britton's proposed work on the mosses of the northeastern United States. In Dr. Geo. Vasey's "Report of the botanist" for 1888 is incorporated a very valuable essay of fourteen octavo pages on the pastoral resources of Montana by Mr. Anderson. It does not pretend to be a complete list of forage plants in Montana, but it does describe well the usual and profitable forage of this country. He had a remarkable talent for making such a list very interesting reading even for the unprofessional. In the same report can be seen three of his drawings, viz: Plantago Patagonica, var. gnaphalioides; Lygodesmia juncea; and Solanum triflorum.

Mr. Anderson is also a valuable example of what a poor boy, without special scientific education, without instruction in a university, with a delicate and treacherous constitution, with poverty always dogging his steps, can do in a short but earnest youth.

Two things he loved with great enthusiasm, good books and botanical novelties. For the books I have seen him spend every cent he possessed; for the other no mountain was too steep, no distance too great, no weariness too distressing for him to endure, that he might lay his hands upon a new flower or grasp a new fungus. He seemed to know by instinct where to find a treasure. The inspiration of his botanical knowledge was intensified by the fact that he gained his knowledge at first hand. He knew whereof he spoke or wrote. Moreover he was a close observer of nature and a diligent collector.

His friendships were keen and constant; slow to form an affection, but once formed they were warm and enduring. He sought his friendships among the good, the diligent and the lovers of nature. By us who knew him best his loss is most keenly felt, and the botanical world is the loser not only of the talent he had exhibited, but, prospectively, of the greater things which his short career promised.

Helena, Montana.

Enumeration of the Kansas mosses.

F. RENAULD AND J. CARDOT.

Kansas, and chiefly the central part of this state, is certainly one of the regions the most destitute of mosses of any part of the United States: the atmospheric dryness, a climate extensively variable and liable to extremes of temperature and the extension of cultivated and meadow lands are the causes of the poverty of this bryological flora. For a long time it was a common belief that this land was almost entirely destitute of mosses; but it has been proved by recent researches that such is not the case, and if the moss-flora of this country is very poor in comparison with that of other states it includes, however, a relatively important number of species. The most part of these, however, grow in meagre, stunted and sterile specimens, which often makes their determination very difficult.

In 1884-85-86 Mr. Eugene A. Rau published in the *Bulletin of the Washburn College Laboratory of Natural History* four contributions to the knowledge of Kansas mosses, including a total of fifty-three species, collected chiefly by Prof. F. W. Cragin, Miss Mara Becker and Mr. Joseph Henry. The last, who died on October 12, 1887, aged more than 74 years, sent us during the year 1885 and until his death, all the species he had collected in Saline county, and by the study of this collection we are able to add nearly forty species to those previously reported by Mr. Rau.

The present catalogue includes all the mosses recorded in the four lists published by this bryologist and all those that we received from Mr. Jos. Henry. Several of these re-

main doubtful, and some specimens, too incomplete to allow any determination, have been omitted.

All the species of which we have received specimens are indicated by the affirmative mark (!); the asterisk (*) indicates those which are not recorded in Mr. Rau's contributions. The geographical names are those of counties unless otherwise noted.

*Sphagnum molle SULLIV.—Saline, a very young sterile form (*Henry*)!
*Micromitrium sp?—Too young for determination. Saline (*Henry*)!
Ephemerum spinulosum BS.— Saline (*Henry*)!
* papillosum AUST.—Saline (*Henry*)!
Phascum cuspidatum SCHREB. (?)—Saline, sterile (*Henry*)!
* var. piliferum BS.—Saline (*Henry*)!
*Microbryum Floerkeanum SCH. var. Henrici REN. & CARD. Bot. Gaz. XIV. 91. (1889). Saline (*Henry*)!
*Pleuridium Bolanderi C. MUELL.(?)—Saline, sterile (*Henry*)!
*Archidium Hallii AUST.—Saline (*Henry*)!
*Astomum crispum HPE.—Saline (*Henry*)!
* Sullivantii SCH.—Saline (*Henry*)!
Weisia viridula BRID.—City of Topeka (*Field*). Shawnee (*Becker, Cragin*). Wyandotte (*Bennett*). Saline, common (*Henry*)!
var. stenocarpa C. MUELL.—Verdigris valley, Wilson (*Cragin*).
Dicranella varia SCH.—City of Topeka (*Cragin*). Shawnee (*Becker*). Saline, common (*Henry*)!
heteromalla SCH.—Saline (*Henry*)! Also a sterile form, with shorter leaves; rather doubtful. Saline (*Henry*)!
Dicranum scoparium HEDW.—Labette (*Nelson*). Saline, sterile form with leaves often broken at point (*Henry*)!
*Campylopus Henrici REN. & CARD. Bot. Gaz. XIII (1888), 197 pl. XIV.—Saline, sterile (*Henry*)!
Fissidens bryoides HEDW.—Saline (*Henry*)!
* Bambergeri SCH.—Saline, sterile (*Henry*)! New to North America.
* obtusifolius WILS.—Saline, sterile (*Henry*)!
* var. Kansanus REN. & CARD. Bot. Gaz. XV (1890), 40.—Saline (*Henry*)!
osmundoides HEDW.—Brown (*Becker*).
Ceratodon purpureus BRID.—City of Topeka (*Field*). Ford (*Cragin*). Saline, a sterile form (*Henry*)!
*Pharomitrium subsessile SCH.—Saline (*Henry*)! with the young form named by Austin *P. exiguum.*
*Didymodon species nova ?—Saline (*Henry*)!
Leptotrichum pallidum HPE.—Saline, sterile form with leaves often broken at point (*Henry*)! Labette, a doubtful sterile form (*Newlon*).
vaginans SCH.—Saline (*Henry*).
*Trichostomum crispulum BRUCH.—Saline, common; several sterile forms (*Henry*)!
*Desmatodon arenacens S. & L.—Saline, sterile (*Henry*)!
* plinthobius S. & L. (?).—Saline, sterile (*Henry*)!—Owing to the absence of fructification, it is almost impossible to decide whether these specimens belong to *Desmatodon plinthobius*, or to *Barbula muralis* Timm.
Barbula Henrici RAU, Bull. of the Washb. Coll. Lab. 1 (1886), 172.—Saline, sterile (*Henry*)! We suspect this plant, known only in sterile state, to be referable to *Pharomitrium subsessile.*
unguiculata HEDW.—City of Topeka, Wilson (*Cragin*). Brown (*Becker*). Saline, common and very variable, but generally sterile (*Henry*)!

fallax HEDW.—Saline ,sterile (*Henry*)!
* convoluta HEDW.—Saline, sterile (*Henry*)!
caespitosa SCHW.—Wabaunsee (*Baldwin*). Saline (*Henry*).
Grimmia apocarpa HEDW.—Saline sterile (*Henry*)!
calyptrata HOOK.—Saline (*Henry*).
* leucophæa GREV.—Saline, common, but sterile (*Henry*)!
* Olneyi SULLIV. (?).—Saline, a sterile stunted form (*Henry*)!
*Hedwigia ciliata EHRH.—Saline, a sterile and very stunted form, with leaves not piliferous (*Henry*)!
*Coscinodon Wrightii SULLIV.—Saline (*Henry*)!
* Renauldi CARD. Bot. Gaz. XV (1890), 41, pl. VI, B.—Saline (*Henry*)!
Orthotrichum strangulatum BEAUV.—Saline (*Henry*)!
Pyramidula tetragona BRID.—Saline (*Henry*).
Physcomitrium pyriforme BRID.—City of Topeka (*Fields, Cragin*). Brown (*Becker*). Labette (*Newlon*).
acuminatum BS.—Long Island, Phillipps county (*Hatcher*.)
* turbinatum C. MUELL.(?)—Saline, sterile (*Henry*)!
Funaria hygrometrica HEDW.—City of Topeka (*Fields, Cragin*). Labette (*Newlon*). Saline (*Henry*)!
Bartramia pomiformis HEDW.—Labette (*Newlon*.)
* radicalis BEAUV.—Saline, sterile (*Henry*)!
*Philonotis Muehlenbergii BRID.—Saline, not uncommon but sterile (*Henry*)!
marchica BRID.—Saline (*Henry*). Reported by Rau, but perhaps referable to the last.
Webera annotina SCHW.—Shawnee (*Becker*).
albicans SCH.—Brown (*Becker*). Wilson (*Cragin*). Saline, sterile (*Henry*)!
Bryum argenteum L.—City of Topeka (*Fields*). Kansas River, Shawnee, Wilson (*Cragin*.) Saline sterile (*Henry*)!
* caespiticium L.—Saline, not uncommon, but sterile (*Henry!*)
bimum SCHREB.—City of Topeka (*Cragin*), Saline (*Henry*).—Perhaps referable to the following.
* pseudotriquetrum SCHW.—Saline, common, but sterile (*Henry*)!
* Ontariense KINDB. Bull. of the Torr. Bot. Club, XVI (1889), 96.—Saline, a few sterile stems (*Henry*)!
Mnium cuspidatum HEDW.—City of Topeka, common (*Fields*). Shawnee (*Becker, Cragin*). Wabaunsee (*Baldwin*). Brown (*Becker*). Labette (*Newlon*). Wyandotte (Bennett). Saline, common (*Henry*)!
affine BLAND.—Shawnee (*Cragin*). Saline (*Henry*).
* var. elatum BS.—Saline, sterile (*Henry*)!
Atrichum undulatum BEAUV.—Saline (*Henry*), reported by Rau, but probably referable to the following variety.
* var. altecristatum REN. & CARD. Bot. Gaz. XV (1890). 58.—Saline (*Henry*)!
angustatum BS.—Town of Tecumseh (*Cragin*). Shawnee (*Becker, Cragin*). Labette (*Newlon*). Wyandotte (*Bennett*). Saline (*Henry*).
* xanthopelma LESQ. & JAMES.—Saline, not uncommon (*Henry*)!
* Fabronia octoblepharis SCHW.—Saline, sterile (*Henry*)!
Thelia asprella SULLIV.—North Topeka (city), and Shawnee (*Cragin*). Brown (*Becker*).
Leskea polycarpa EHRH.—Town of Wakefield, Clay (*Cragin*). Shawnee, Brown (*Becker*). Wyandotte (*Bennett*). Saline, common, several forms (*Henry*) !
Austini SULLIV.—Saline (*Henry*)!
Anomodon rostratus SCH.—Wabaunsee (*Baldwin*). Verdigris valley, Wilson (*Cragin*.) Saline, sterile (*Henry*)!
attenuatus HARTM.—Wyandotte (*Bennett*.)
obtusifolius BS.—City of Topeka (*Fields*). Brown (*Becker*). Saline (*Henry*)!

Pylaisia intricata BS.—Jefferson (*Cragin*). Saline (*Henry*)!
*Cylindrothecium cladorrhizans SCH.—Saline (*Henry*)! with a form much resembling *C. brevisetum* by its stems and branches less compressed, and its pedicel shorter.
seductrix SULLIV.—Shawnee (*Cragin, Becker*). Wabaunsee (*Baldwin*). Brown (*Becker*).
* compressum BS.—Saline (*Henry*)!
*Climacium dendroides WEB. & MOHR.—Saline sterile (*Henry*)!
*Thuidium recognitum LINDB. ? Th. delicatulum LINDB. ?—Saline, sterile (*Henry*)!
Brachythecium lætum BS.—Shawnee (*Becker*). Wabaunsee (*Baldwin*). Labette (*Newlon*). Saline, sterile (*Henry*)!
* var. dentatum LESQ & JAMES.—Saline, sterile (*Henry*)!
acuminatum (BEAUV).—City of Topeka (*Fields*). Shawnee, Brown (*Becker*). Wilson (*Cragin*). Saline, common, but sterile (*Henry*)!
rivulare BS. (?).—Saline (*Henry*). Wyandotte (*Bennett*).
plumosum BS. (?).—City of Topeka (*Fields*). Saline, doubtful (*Henry*.)
Eurhynchium strigosum BS.—Wabaunsee (*Baldwin*).
* praelongum BS.—Saline, sterile (*Henry*)!—Lesquereux and James, in the "Manual of the Mosses of North America," p. 353, state that "the true *Hypnum praelongum* has scarcely been found on this continent," where its place is supplied by the *H. hians* Hedw. However, all the specimens we have hitherto seen from North America are found quite identical with the European forms of *H. praelongum*, their leaves being serrulate all around, a character which does not agree with description of *H. hians*.
hians (HEDW.)—Shawnee (*Becker, Cragin*).

Rhynchostegium serrulatum (HEDW.)—City of Topeka (*Fields*) Wabaunsee (*Baldwin*). Jefferson (*Cragin*) Saline, sterile (*Henry*)!
Plagiothecium sylvaticum BS.—Saline (*Henry*).
Amblystegium serpens BS.—City of Topeka, Tecumseh (*Fields, Cragin*). Shawnee (*Becker, Cragin*). Brown (*Becker*). Jefferson (*Cragin*) Saline (*Henry*)!
* varium (BEAUV.)—Saline, common (*Henry*)!
* porphyrrhizum SCH.—Saline, (*Henry*)! Seems to be identical with *A. hygrophilum* Sch.
* adnatum (HEDW).—Saline, sterile (*Henry*)!
riparium BS.—Brown (*Becker*). Saline (*Henry*)!
var. cariosum SULLIV.—Saline (*Henry*).
* var. serratum REN. & CARD. Bot. Gaz. XIV (1889), 98.—Saline (*Henry*)!
* Kochii SCH.—Saline (*Henry*)! New to North America.
Hypnum hispidulum BRID.—Shawnee (*Cragin*). Brown (*Becker*). Saline (*Henry*)!
chrysophyllum BRID.—Labette (*Newlon*). Saline, sterile (*Henry*)!
aduncum HEDW.—Saline, sterile (*Henry*)!

Surveying the whole of this bryological florula it becomes immediately evident that the most part of the species are characteristic for the flora of the middle and eastern states. As such are chiefly to be noted: Sphagnum molle, Micromitrium ?, Ephemerum spinulosum, E. papillosum, Astomum Sullivantii, Fissidens obtusifolius, Pharomitrium subsessile, Leptotrichum vaginans, Desmatodon arenaceus, Grimmia Olneyi ?, Orthotrichum

strangulatum, Philonotis Muehlenbergii, Bryum Ontariense, Fabronia octoblepharis, Thelia asprella, Leskea Austini, Anomodon rostratus, A. attenuatus A. obtusifolius, Pylaisia intricata, Cylindrothecium cladorrhizans, C. seductrix, C. compressum, Brachythecium laetum, B. acuminatum, Rhynchostegium serrulatum, Amblystegium varium, A. adnatum, Hypnum hispidulum, H. chrysophyllum.

The following species belong to the flora of the southern states (Texas Louisianá, etc.) and reach here their extreme limit northward: Archidium Hallii, Desmatodon plinthobius ?, Barbula caespitosa, Physcomitrium turbinatum ?, Bartramia radicalis, Atrichum xanthopelma.

Grimmia calyptrata and Coscinodon Wrightii seem more especially peculiar to the flora of the Rocky Mountains. Trichostomum crispulum and Pleuridium Bolanderi ? were hitherto only recorded from California.

Monaco, and *Stenay*, *France*.

Noteworthy anatomical and physiological researches.

Ovular structure of Casuarina suberosa.[1]

In this work of Treub's we have a very good example of the sensational in plant morphology. The word is not at all to be taken in a bad sense but fitly describes the altogether unsuspected results which have followed this careful investigator's examination of a group of plants of acknowledged difficulty. After discussing the insertion of the ovules and their curious displacements which have caused much discussion (see on this Baillon, Eichler, Miquel and Engler), Treub takes up the ovular structure with the following conclusions:

1. Certain large sub-epidermal cells in the young ovule are an archesporium and develop the macrospores (embryo-sacs). They lie at the summit of the nucellus and undergo a series of tangential segmentations, finally producing a thick cylinder of sporogenous tissue which, surrounded by the tapetal layer, occupies a central position in the nucellus.

2. The cells of the sporogenous layer develop tetrads of spores, of which three become absorbed, in some cases, but in

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[1] Treub: Sur les Casuarinèes et leur place dans le system natural. Ann. Jard. Buitenz. x. 145–231.

others may be seen to form tracheids which are thus analogous to the elater cells of Hepaticæ The latter condition is the one observed in *Casuarina glauca* and *C. Rumphiana.*

3. Twenty macrospores are found and these elongate in the plane of the greater axis of the nucellus.

4. The micropylar ends of the macrospores develop two or three small cells which are to be considered as homologous with the canal-cells of the Eu-archegoniata and not as synergidæ. Generally only one of the macrospores has these cells endowed with a cellulose wall and this cell is the future embryo-sac.

5. The pollen tube divides, after reaching a nucellus, into at least two branches—thus reminding one of the well known phenomena in Taxus, Juniperus and Salisburia where one pollen tube is employed for the fertilization of several egg-organs.

6. A large number of endosperm nuclei are formed before the embryo is developed, thus indicating again the similarity of these cytogenetic sequences to those of the Gymnospermæ (Archispermæ).

7. Casuarina is therefore believed to occupy a decidedly anomalous position among the Metaspermæ (Angiospermæ). It is nearer to the Archispermæ than any form yet examined and may be given a place apart from the rest of the higher seed-plants. Treub proposes the following classification to admit Casuarina to its proper place, as indicated by his researches:

Archispermæ.		
Metaspermæ	Chalazagameæ ::	Casuarina.
	Porogameæ ::	Dicotyledoneæ.
		Monocotyledoneæ.

Casuarina, the only genus of its family, contains about 30 species. They are of limited range, being found principally in Australasia. A very good account of them may be found in Grisebach's *Vegetation der Erde*, and in Engler's *Natürliche Pflanzenfamilien* there is a fair figure showing their remarkable habit of growth—so similiar to that of Equisetum that they were originally classed with that genus. They are characteristic plants in the Australian forests and with their vegetative and distributional features taken into account, it is not inherently improbable that the singularly isolated position as-

cribed to them by Treub is a correct one. Their future examination is likely to be productive of much interest.—CONWAY MACMILLAN.

A contribution to the knowledge of nuclear mechanics in the sexual and other reproductive cells of plants.[2]

The paper of Guignard here noted is remarkable not only for the brilliant series of researches which it chronicles but also for the able review of a mass of literature which is not yet very well known to any except a small coterie of specialists. Reference is made to the memoirs on the subject of the intimate phenomena which are now known to go on in both plant and animal cells in process of division, and have been called the spermatokinetic and ookinetic processes. Guignard gives a résumé of the important conclusions which have been reached in both the plant and animal world and adds some luminous suggestions concerning the physical basis of heredity. A numbet of the facts brought forward in this paper are not altogether new, having before appeared in recent works of the same author, but the generalizations and many of the illustrative examples are not hitherto published. Guignard has been studying the development of pollen and embryo-sacs—particularly in *Lilium martagon*—and has followed out in great detail the complicated and yet altogether orderly nuclear phenomena which invariably accompany the act of reproduction and are part of its very essence. Without the aid of any very extraordinary technique or the necessity of unusually difficult manipulations he has contributed a number of extremely interesting observations along his line of work. Some of these may be briefly noted.

1. Just outside the nuclear membrane in all cells examined there are to be distinguished two small spheres of protoplasm—called by their discoverer "directive spheres." They are not easily stained by ordinary methods. These two spheres lie side by side in the resting nucleus but when the nucleus begins to divide they are seen to have a special position and function to perform. They separate and pass to opposite ends of the nucleus and form the astrocenters towards which the chromosomes slowly move and accomplish the division of

[2]Guignard: Nouv. études sur la fécondation, Ann. Sci. Nat. Botan., Ser. VII. XIV. pp. 163—288.

the colorable nuclear elements. While the division is in what is commonly called the "spindle" stage the astrocenters each divide and thus form at each end of the old nucleus a *pair* of directive spheres. With the development of the nuclear membranes in the two daughter-nuclei the spheres take up their normal positions and the process may be repeated as the divisions continue. It is this contribution to our knowledge of the morphology of the astrocenter that counted so much for Guignard in the assignment of the Prix Bordin, just awarded him by the French Academy.

2. In mother-cells of spores the nuclear plate consists of twenty-four chromosomes but in the spores themselves and in sexual cells the number is only twelve. The sexual act then consists in the *addition of a number of chromosomes, that brings the number up to the normal again.*

3. These chromosomes are purely passive and their union is a function of the directive spheres which accompany them just outside the nuclear membrane which encloses the chromosomes themselves. This is brought about as follows in L. martagon—the plant of particular study:

4. After the pollen tube has reached the egg-cell, which lies in the embryo-sac immediately behind the two synergidae, the male nucleus is seen to pass over to the egg-cell and take up a position beside it in such a way that the two directive spheres are in contact with each other. The two nuclei generally lie in the same horizontal plane but in rare cases one may lie above the other. The two spheres now slip out in pairs, one pair going to what will be one pole of the now almost mature segmentation nucleus and the other pair going to what will become the other pole. As the nuclear membranes, now in close contact, dissolve, the central portions of each pair of spheres (the centrosomes) become merged and a *single directive sphere lies at each pole of the segmentation nucleus*. These become the astrocenters for the segmentation nucleus. Since the male nucleus contains more easily stained chromatin than the female, Guignard was in many cases able to tell, by examination, which chromosomes in the segmentation nucleus had come from the male plant and which from the female. He found that after the absorption of the membranes lying between the two copulating nuclei and the formation of the plate in the segmentation nucleus the male

and female chromosomes were shifted about in such a way that some of both kinds were diverted to each pole.

5. The two most important theoretical considerations noted, are, first, that the nucleus can no longer be considered as taking the initiative in the work of cell-fusion but this must be given back to the protoplasm from which the directive spheres are formed. The nuclei are but passive parcels of hereditary substance transmitted from one cell to another and always under the dynamic control of the spheres. Second, the male and female sexual cells transmit the same number of chromosomes and thus indicate that they have an equivalent part in the heredity and that the view that the male is merely a stimulant or irritant under which the female nucleus takes on the character of a segmentation nucleus is not supported by the facts of morphology in the case in hand.

The article is given a fitting close by ten of those plates which are made nowhere but in Paris. In them one can follow with the greatest ease the investigations of the author and alone they constitute no mean addition to the literature of mitosis.—CONWAY MACMILLAN.

Burnt spots on leaves.[1]

It is a well known fact, that the green parts of plants, especially the leaves, may show local or partial decolorations, due to different factors. We do not speak of the decoloration which is generally referred to chlorosis or etiolation, but of the yellow, brown or perfectly black spots which are not uncommon upon the leaves of plants kept in greenhouses. Such spots may be due to parasitic animals or plants or to inorganic agents. In the last case they are characterized as "burnt spots." This disease has been recorded in literature long ago. Burnt spots have been attributed to several pathological changes, which, although they showed great similarity to those caused by a relatively high temperature, nevertheless originated from quite different factors.

One of the oldest theories to account for these, and as it seems the only acceptable one, was that which ascribed them to the common presence of air-bubbles in the glass used as cover for green-houses. The air-bubbles were supposed to have

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[1] JŒNSSON BENGT: Om brænnflæckar paa væxtblad. Botaniska Notiser. Lund 1891. 30 pp. 2 colored plates.

the effect of lenses, by which the sunlight became concentrated and thereby caused a burning of the exposed parts of the leaves. Another theory, quite generally adopted, was that drops of water left on the leaves after they had been watered, might have the same effect as lenses or by their own heat be able to burn the leaves, especially in houses without sufficient ventilation.

De Candolle suggested that the burning might be caused by the drops of water, which at once softened the tissue of the leaves, became heated in the sunlight and thereby prevented evaporation. In *Gardener's Chronicle* for 1858 burnt spots on orchids were said to originate from too much moisture in connection with too low temperature.

The explanation most commonly adopted, however, is that which attributes the effect to drops of water having been heated by the sunlight and it has been so recorded in the more prominent phytopathological manuals. Sorauer for instance in his *Pflanzenkrankheiten* explains the fact quite briefly by this statement. Neumann[1] came to the same conclusion by some experiments he made with *Cordyline.* On the other hand he observed that if the leaves were fastened in a certain position they were burnt even if there was sufficient draught. Another author, who has almost adopted the same theory, is Frank[2], although he does not exclude the possibility that the drops of water might also be able to act as lenses. And he found support in Hoffmann who was the first to show, by experiments on grapes, that drops of water in a hanging position are able to concentrate the sunlight and to produce burning. Later von Thümen[4] expressed full accordance with Hoffmann. But the old theory, that the burnt spots were caused by air-bubbles in the glass, seems to have been entirely abandoned, although Neumann (l. c.) was not quite unaware of the possibility of its correctness; he did not believe, however, that such air-bubbles could burn except through very short distances.

The author of the present paper calls attention to the fact that the true burnt-spots are easily distinguished by their

[1]Adansonia, Vol. II, 1862, p. 312.

[2]Die Krankheiten der Pflanzen, 1880, p. 174.

[3]Samenbruch bei der Weinbeere, Botan. Zeitung 1872, p. 113.

[4]Ueber den Sonnenbrand der Rebenblætter, Die Weinlaube 1886, p. 409.

most frequently elliptical form with the longest diameter often from east to west, and if they occur several together on one leaf, they form always longitudinal rows from east to west, the spots in the middle being the largest. He has made a series of experiments so as to test the different theories, which have been enumerated above. It has been thereby proved, that drops of water are unable to cause any kind of burning by their own heat. Further, as shown by Sachs, the vegetative cell of land-plants is able to stand a heat of 51° C. All the experiments, made by the author in that direction, gave negative results, so that Neumann's theory cannot be correct. Some experiments were made with water of a temperature above 60° C., but even this did not affect the leaves.

As regards the supposition, that drops of water might have the same effect as lenses, it is quite clear that drops which have fallen on leaves merely represent half-lenses, a fact to which already De Candolle has called attention. And it is shown by experiments, that only when the drops of water were out of contact with the leaves, do they become able to cause a kind of burning, for instance when hanging down from the inside of a glass cover.

The author has come to the conclusion that in most cases the burnt spots are due to the poor quality of the covering glass, by the air bubbles of which the sunlight becomes concentrated so as to produce a burning on the leaves.—THEO. HOLM.

BRIEFER ARTICLES.

Cleistogamy in the genus Polygonum.—On page 273, vol. XVI, BOTANICAL GAZETTE, it is noted that "Mr. Thomas Meehan has found cleistogamous flowers in abundance on *Polygonum acre* and suspects the same habit in other species." On page 314 of the same volume of the GAZETTE, Mr. T. H. Kearney, Jr., records his observation of cleistogamous flowers upon *Polygonum acre* at Knoxville, Tenn., accompanying his note with figures. Mr. Kearney farther states that he has "searched for cleistogamic flowers on other species of Polygonum without success."

I am led by the appearance of these notes to state that in my studies of the genus Polygonum, I have found cleistogamous flowers

on many species, thus verifying the thought of Mr. Meehan. From an examination of my preliminary notes upon the genus, verified by a reëxamination of the specimens, I report the finding of cleistogamous flowers upon the following species: *P. arifolium*, in which the achenes in my specimens were incompletely developed; *P. Bolanderi*, *P. Californicum*, *P. Careyi*, *P. Hartwrightii*, *P. Hydropiper*, the condition being extremely common in this species; *P. hydropiperoides*, in which in every case examined the achenes were perfected; *P. lapathifolium*, *P. maritimum*, *P. ramosissimum*, in which case, however, I am not thoroughly convinced as to the cleistogamous character of the flowers so referred; *P. sagittatum*, and *P. Persicaria*. I found that in almost every case in which I had *late* collections of the species mentioned above, cleistogamous flowers existed. That more species are not included in the list is, I am inclined to believe, due to the fact that the specimens of the other forms in my possession were collected in the earlier portion of their season. I believe that in all cases where collections are made after Sept. 15th, cleistogamous flowers may be reasonably expected.

The figures given by Mr. Kearney in the note referred to above present an exceptional condition. In the many forms which I have examined it only occurs once or twice. Ordinarily the cleistogamous flowers are completely concealed by the sheath, but if well developed their presence may be detected by the appearance of an apparent intumescence of the sheath on one side of the stem and slightly above the node. Occasionally when the sheath is short the tip of the flower may be seen projecting a little beyond its border. In the ordinary herbarium specimen, unless care is taken in the dissection, the flower will be taken for a fragment of the sheath, unless indeed the achene be well developed. I have as yet detected only a single flower at each node, but am not prepared to say that this is the rule.

In this connection I would like to ask botanists throughout the country to send me any notes they may have upon the genus, and to state that I would be glad to receive specimens for examination from such as are willing to spare them for a sufficient time for their proper study.— STANLEY COULTER, *Purdue University, La Fayette, Ind.*

Cultivating the ascosporous form of yeast.—The methods usually recommended for securing the ascosporous state of yeast, i. e. by cultivation upon slices of potato or other vegetables, or even upon plaster of Paris slabs, have always ended in failure in my laboratory, until a recent trial by the method suggested by Hansen.[1] This method con-

[1] Les ascospores chez le genre Saccharomyces. Comp. rend. trav. du lab. de Carlsberg, ii, p. 30; also see Zopf, Die Pilze, p. 414.

sists essentially of securing particularly vigorous, actively growing yeast plants, which are transferred directly to moist slabs of plaster of Paris, on which they develop the spores very rapidly. The sudden change from the condition with abundance of nutriment to one with almost total absence of it, appears to call out the extreme reproductive safeguard of the species against annihilation.

Hansen advocates starting with pure cultures, from which some cells of yeast are transferred to beerwort for a short time at common room temperature, then a small quantity of the active cells is again removed to fresh beerwort for 24 hours at a temperature of 26–27° C. A supply of the cells thus obtained is sown upon sterilized blocks of plaster of Paris, which are made sufficiently moist to slightly glisten, and are afterward kept in a moist chamber at proper temperature.

The method followed in my laboratory was to add a little yeast, taken from a fresh cake of Fleischmann's compressed yeast, to a Pasteur solution. In a day or two, when the disengagement of gas showed that the yeast was in active growth, the liquid was poured out of the flask, some of the flocculent material adhering to the glass was spread upon the surface of a freshly made cake of plaster of Paris, which was barely moist, and the whole was covered to prevent drying out. The cakes were made by stirring water into powdered plaster of Paris and allowing it to harden in a shallow covered dish. In a few days a most abundant crop of ascospores was obtained. The spores are easily colored with methyl violet; and fine permanent mounts may be made by the coverglass method as used for bacteria.

The work was carried out by Messrs. Wright and Van Pelt of the present senior class.— J. C. ARTHUR, *Purdue University, La Fayette, Ind.*

EDITORIAL.

THERE IS a wide field for American ingenuity in devising new adaptations of apparatus used in other departments, and in inventing new forms of apparatus, with which to illustrate the main truths of vegetable physiology. Much work of this kind must be done before the science can be so generally taught in high schools and colleges as its position as a fundamental science demands. Special forms of apparatus will naturally be brought out to meet the requirements of investigators working in original lines, which will enrich the available supply, but new methods of making old truths clear by means of

simple yet well constructed apparatus, are needed in all present laboratories. Not only do we need new kinds of apparatus, but it is also a matter of moment to know where both the old and new forms can be purchased at a reasonable price and without too great delay. At the present pedagogical stage of the science it is possible to buy only a few pieces that the books describe, and those must largely be imported at a cost that in some cases effectively excludes them from many laboratories. The annoyance of determining proportions, making drawings and carefully describing the required pieces in order to have them made to order, even for glassware, is too laborious and time-consuming to permit of doing much of it. At present many teachers are driven to making their own apparatus as best they can, which as a rule is not an economic expenditure of the teacher's time or of the institution's funds. Until the facilities for purchase, which now obtain for microscopical, physical, chemical and other kinds of apparatus, also embrace physiological pieces, laboratories will not multiply, and the science be taught with the completeness that its importance demands.

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BOTANISTS, particularly those of the upper Mississippi valley, have been watching with considerable interest the formation of the faculty of the new Chicago University. Hopes have been raised, as we noted the high scholarship and particularly the high degree of specialization of the men that were being appointed, that the chair of botany would be filled with some specialist of repute, and that thus the new institution would set the pace for some of the older ones that have shown themselves laggards.

BUT WE CONFESS that it was with a feeling of sore disappointment that we read in the Chicago papers of the appointment of a professor of "biology." Apparently it is to be the old story of zoölogy masquerading in borrowed plumage as biology, for the gentleman who has has been appointed is a well-known zoölogist. As to his qualifications on the botanical side we know nothing, but we do know that no one man can teach biology properly in such an institution as the Chicago University bids fair to be. It would be a difficult feat for one man to teach zoölogy alone or botany alone, as it should be taught; to ask him to teach both, savors too much of the time when a man could be "professor of natural science."

IT IS SINCERELY to be hoped that President Harper will see to it that he chair of biology is divided before zoölogy teaching comes to stand for biology in the institution from which we expect so much. If this

is not done we shall not be surprised to have an early announcement similar to that in the December number of the *American Naturalist*, in which appears the naive item — we are sure our readers will appreciate its fine humor — "Prof. C. H. Gilbert is professor of *Vertebrate Biology* in Leland Stanford University."

IN THIS CONNECTION we are much pleased to note the establishment of a new chair of histology and cryptogamic botany at Cornell University. This is a move in the right direction.

CURRENT LITERATURE.

Kuntze's "Revisio Generum Plantarum."[1]

This is one of the most ambitious botanical works of recent years, and has involved a prodigious amount of labor. However botanists may differ as to its conclusions, they must always be grateful for the vast amount of facts thus brought together. It is becoming more and more apparent that the nomenclaturists are not to agree with each other, at least until another congress has definitely established a datum line. In the meantime the systematist who is not a nomenclaturist feels inclined to reserve his opinion until the dust has settled somewhat and things can be seen more clearly. When all the ancient records have been searched, and books like those before us have become numerously multiplied, and confusion worse confounded reigns, some one will begin to bring order out of chaos, stability out of upheavals. There is no desire here to criticize the efforts of nomenclaturists, of whom Dr. Kuntze seems to be the bright consummate flower, but to emphasize the fact that we are still in the period of "stirring up," not of "settling." Devoid of all principles, sound or otherwise, we hold ourselves in readiness to accept and use any name which gives promise of a reasonable tenure of life.

The GAZETTE has often given, and still maintains the opinion that the necessary changes in nomenclature should never be attempted in this wholesale fashion, but that they should be made by monographers, who have an abundance of material before them and know whereof they speak.

The volumes before us are such as will demand consultation by all those who deal in phytography. The wealth of reference is marvel-

[1] KUNTZE, OTTO.— Revisio Generum Plantarum vascularium omnium atque cellularium multarum secundum leges nomenclaturæ internationales cum enumeratione plantarum exoticarum in itinere mundi collectarum. 2 vols. 8 vo. pp. clxvix, 1011. Leipzig, London, Milan, Paris, New York (Gust. E. Stechert, 828 Broadway), 1891.

lous, while dates of genera and important works will furnish a mine of information to all systematists who do not have access to the extensive literature to be found at London and Berlin. The author seems to have caused most confusion by taking up the generic names of the first edition of Linnæus, Systema, instead of the first edition of his "Genera Plantarum." To illustrate, it may be imagined what confusion will arise in changing Nasturtium to Cardamine, Arabis to Erysimum, Lepidium to Nasturtium, and Sisymbrium to Hesperis. Upon the flimsiest pretext for example, Tragacantha replaces Astragalus, and its nearly 1500 species are renamed. To mention all the suggested changes, or even the startling ones, that have to do with North American plants would be impossible in the space at our command, but in this connection we are glad to call attention to the excellent service rendered by our friend, Dr. Britton, in printing in the February *Bulletin* the principal changes suggested for the generic names of North American plants, a service rendered still more valuable by his own annotations.

The plant world.[1]

Under this title Mr. Massee has published what appear to be lectures originally prepared for use under the auspices of the London Society for the extension of university teaching, to which society Mr. Massee is a lecturer. These lectures deal with plant architecture; the chemistry and physics of plant life; protective arrangements; reproduction in plants; relationship amongst plants; fossil plants; and the geographical distribution of plants.

Mr. Massee is a botanist of no mean repute, and one expects more of him than of an unknown tyro. The ground covered by this little book embraces some of the most interesting portions of the science. We wish that we could say that it is a readable book. It has very much in it to which no exceptions could be taken; much that is interesting and well put. But it is exceedingly uneven. In the main it is accurate, though not infrequently the writer's meaning is obscure because of his faulty English. This is the more remarkable by reason of the general clearness of Mr. Massee's scientific papers. On the side of fact the histological part of the chapter on plant architecture is perhaps the worst, and this also is marked by the poorest illustrations.

As a whole the style is very bad. The sentences are long and involved. Occasionally they extend to enormous lengths. We note one

[1] **Massee, George**:— **The plant world, its past, present and future; an introduction to the study of botany. 12 mo., pp. x. 212, figs. 56. London: Whittaker & Co. (New York: Macillman & Co.) 1891. 3*sh*. 6*d*.**

on pages 82 and 83 which is over a page long and contains 339 words, equalling about three-fourths of a page of the GAZETTE. Those covering half a page are frequent. These long sentences seem to be constructed on the same principle as the mnemonic word-chains; the thing with which the writer began reminded him of something, that of something else, and so on until by the time the period is reached one finds that he is talking of something rather remote from that with which he began. Here is a sentence which sadly needs mending: "It must be understood that potassium is not the only factor necessary for the formation of starch; but if this substance is absent, even if all other conditions are favorable, as in the case of iron and chlorophyll so also with starch which contains no potassium, the latter being necessary for promoting the chemical changes resulting in the formation of starch." p. 56.

We fear also that Mr. Massee's generalizations will be found much too sweeping. The voice is the voice of Massee, but the reasoning is the reasoning of Grant Allen. It is taking, but it is not sound.

Making a charitable guess we should say that Mr. Massee had been persuaded to allow his lectures to be printed without having or taking sufficient time to revise them properly. If these popular books were to be read only by specialists there would be little mischief in erroneous or faulty statements. But no book demands so much of an author as one that is prepared for readers who are not able to separate the wheat from the chaff. This book needs a little winnowing, and the grains of truth should be thoroughly brushed before they go through the mill of the "general reader."

Minor Notices.

THE VERY INTERESTING address of Dr. George L. Goodale as retiring president of the A. A. A. S. on the useful plants of the future, and some of the possibilities of economic botany, has been distributed in reprints from the *Proceedings* of the association.

THE MALTREATMENT of our shade trees and the diseases which are likely to follow the mechanical injuries which are inflicted upon them by thoughtless drivers, ignorant trimmers and ruthless linemen, formed the subject of an address before the Massachusetts Horticultural Society by Dr. W. G. Farlow, which has recently been reprinted from the *Proceedings* of the society. The society was urged to make an effort to secure legislation which should make compulsory the placing of guards around trees and the entrusting of the care of trees in public grounds only to persons specially trained for the purpose. The GAZETTE would bid such efforts God-speed.

IN CONNECTION with the paper of the series on flowers and insects published in this number from the pen of Mr. Charles Robertson, it may be well to call the attention of all our readers who are interested in these topics, to the paper of the same series printed in the *Transactions* of the St. Louis Academy of Science, vol. v, p. 569. The orders therein treated are the Asclepiadaceæ to Scrophulariaceæ.

IN A RECENT bulletin, notable as being no. 1 of the division of vegetable pathology, Dr. Erwin F. Smith adduces additional evidence of the communicability of peach yellows and peach rosette. The latter disease has been considered a form of the yellows, but Dr. Smith has recently described it as a different disease. It is spreading in the archean region of Georgia, and is more virulent than the yellows. Extermination of diseased trees is the only measure that can be suggested at present.

MR. JOHN ROBINSON published in the *Salem Gazette*, during the summer of 1891, a series of articles upon the trees of Salem and vicinity. These papers have since been revised, and now appear in pamphlet form issued by the Essex Institute. They were written for popular entertainment and instruction, but in Mr. Robinson's hands they have been made full of interest to botanists as well.

DR. GEORGE VASEY'S "Grasses of the Southwest," Part II, completing the first volume, has been distributed, and fully sustains the excellent character of Part I. Fifty species are illustrated by most excellent full page plates, and facing each plate is the descriptive text. We could have wished that with every description a full statement of the range of the species could have been given. The trimming of the leaves also has made binding difficult, for any further reduction will cut into the titles of plates or the figures themselves.

"THE GENUS POLYGALA IN North America," by Wm. E. Wheelock, is the title of the fourth and last number of Volume II of the "Memoirs of the Torrey Botanical Club." Mr. Wheelock has studied the specimens found in the largest American herbaria and Dr. Britton has examined most of the types preserved in Europe. The species number 38, and of these very full descriptions, synonymy, and range are given. A new species from Texas (*P. Tweedyi* Britton,) is described, and some new varieties proposed. *P. fastigiata* Nutt. (1818) is *P. Mariana* Mill. (1768); and *P. viridescens* L. replaces *P. sanguinea* L. of same date. The error of date under *P. Rugelii* had better be corrected. It should read Shuttleworth, Chapm. BOTANICAL GAZETTE, iii. 4 (Jan. 1878).

PROFESSOR GREENE'S *Flora Franciscana*, Part II, continues that important work through 24 additional orders. The succession of families

is interesting to those only familiar with the ordinary sequence. The intercalation of Apetalæ among Polypetalæ has long been a much desired change, and it is a good thing to have it put in this concrete way and applied to our North American plants. The changes in generic and specific nomenclature are mostly such as Professor Greene has already indicated in previous papers.

OPEN LETTERS.

The new herbarium pest.

In reference to the article in the December number, 1891, by Prof. C. V. Riley on the "New Herbarium Pest," let me add my experience. Today in looking over duplicates four of the geometrid larvæ were found on Aphyllon Ludovicianum collected in this county in June, 1890. A few drops of a pretty strong solution of corrosive sublimate and arsenic in diluted alcohol were dropped on each. During an examination of the plants for more larvæ or eggs, in about twenty minutes, the liquid had evaporated, and the paper being again dry, I observed to my dismay the little surveyors stretch and move again, slowly at first, but in about five minutes as actively as before their bath. They are now bottled for observations. This extraordinary tenacity of life increases the formidability of this pest.—DR. H. E. HASSE, *Santa Monica, Calif.*

NOTES AND NEWS.

THE STATE OF KANSAS is spending $3500 in spreading the entomophthoral disease of chinch bugs under the direction of Professor F. H. Snow.

PROFESSOR W. C. WILLIAMSON, until recently at Owen's College, Manchester, has changed his residence to 43 Elms Road, Clapham Common, London.

DR. SERENO WATSON died March 9th, at his home in Cambridge, Mass., after a prolonged illness resulting from an attack of "la grippe." No tidings since the death of Dr. Gray will cause botanists profounder sorrow than this.

DR. THOMAS TAYLOR, the United States microscopist, is said to be preparing models of fungi for the Columbian Exposition, to include all the edible varieties of the United States.

THE DECEMBER NUMBER of the *Microscopical Bulletin* contains a very fine photogravure of Bacillus tuberculosis made from a photograph taken with Queen's 1-15 homogeneous immersion lens.

THE UNIVERSITY EXTENSION work of the State University of Iowa embraces twelve lectures on "world-making," four of which are devoted to plants. The botanical lectures are given by Professor T. H. McBride.

MRS. W. A. KELLERMAN has been writing very pleasantly about leaf variations, which she has observed from time to time. Several of her articles have appeared in *Science*, in the issues for Jan. 29, Feb. 12, and others.

THE HERBARIUM of the University of Minnesota contains about 42,000 plants, including 15,000 spermaphytes. It embraces sets of exsiccati by Ellis, Thümen, Sydow, Roumeguère, Krieger, Rehm, and some others, in the fungi.

TWENTY-THREE CALIFORNIAN WEED SEEDS are illustrated and described by Mr. Hubert P. Dyer in the annual report of the California Experiment Station for 1890, recently issued. The article is part of a graduating thesis.

A CERTIFIED list of exchanging botanists, classified according to their ability and usual practice in the preparation of herbarium specimens, is being compiled by Mr. J. A. Morton, secretary of the Canadian botanists' correspondence association.

THE SOURCE OF INFECTION for wheat rust is discussed by Professor H.L. Bolley in *Agricultural Science* for last December. He concludes that the uredospores are the chief generators of the rust, and that the wind may carry them very long distances, even hundreds of miles.

A REVISION of the North American species of Xyris, by Heinrich Ries, is published in the *Bulletin* of the Torrey Botanical Club (Feb.). Fourteen species are described (one new) and their range and synonymy given.

PROF. E. B. KNERR, of Midland College, Atchison, Kansas, will furnish fresh rooted specimens of *Erythronium mesochoreum* KNERR this spring to all who desire them, provided they send ten cents (to cover postage and packing) with their addresses. The plant usually begins to bloom shortly after April 1st.

MR. HAROLD WAGER of Leeds claims to have demonstrated the presence of a nuclear structure in a species of Bacillus which forms a thin scum on water containing Spirogyra in a state of decay. These researches combined with earlier ones leave little doubt of the presence of a nucleus at least in the more highly organized microbes.

SINCE THE appearance of Kuntze's *Revisio Generum Plantarum* Dr. John Briquet, who is elaborating the Labiatæ for Engler and Prantl's *Natürliche Pflanzenfamilien*, has examined the changes proposed by K. in the generic names of this order. Out of the fifteen suggested he considers five well founded.[1]

MR. R. E. FRY finds in certain cells of the stem of Euphorbia splendens aggregations of proteid which are "used as a reserve nitrogenous material, answering to starch among carbo-hydrates." Other species of Euphorbia and allied plants do not exhibit aggregations of such material.[2]

[1] Bot. Centralb. xlix. 106.

[2] Annals of Botany v. 413.

THE OUTLINES of a university extension course of six lectures on the physiology of plants, which is being given at Tomah and Appleton, Wis., by Dr. Charles R. Barnes, have been distributed. The topics of the lectures are as follows: "How plants forage; How plants eat; How plants breathe; How plants grow; How plants move; How plants multiply."

PROFESSOR J. E. HUMPHREY has given in the *American Naturalist* (Dec.), under the title "The comparative morphology of the fungi," a very useful outline view of the conclusions contained in the last four parts of Brefeld's "Untersuchungen aus dem Gesammtgebiete der Mykologie;" views with which not merely every mycologist should be familiar, but every student of botany.

A LEARNED, interesting and suggestive lecture by Mr. Charles F. Cox of New York city, on the question, "What is a diatom?" is given in the January number of the *Journal of the New York Microscopical Society*. It not only answers the question from the technical and biological sides, but presents a strong plea for the toleration and encouragement of the study of pure science, based upon the history of the development of knowledge as influenced by the study of these organisms.

IN THE ANNUAL REPORT of the President of Harvard College, for 1890–91, it is stated that during the year the total number of specimens received by the Herbarium was about 13,000, and the number mounted and distributed 10,995. The total expenditure of the Herbarium was $6329.84, against $3048.60 in 1889–90, and $4493.23 in 1888–89. The additional expenditure of 1890–91 was made possible by the gift of $3500 a year for five years. This gift was made in the hope that it would ensure the completion of the Synoptical Flora.

IN BULLETIN 37 of the Cornell Experiment Station Professor Bailey gives a lucid account of the three species of Physalis which have come into cultivation as fruit-bearing plants, viz., P. pubescens, P. Peruviana and P. capsicifolia.— Prof. Bailey thinks that if some way can be found to make the pepino (Solanum muricatum), a very interesting plant of recent introduction, set fruit more freely in the north it promises to be an acquisition for the kitchen-garden and for market. — He recommends the chorogi (Stachys Sieboldi), the new tuberiferous labiate, for trial in every home garden.

SOME YEARS AGO Van Tieghem demonstrated the existence of invertase in pollen, a ferment which converts cane sugar into glucose. Experiments carried on by Mr. J. R. Green demonstrate the presence of diastase in the pollen of a number of common cultivated plants. Fresh pollen ground up between glass plates and mixed with a thin starch paste produced the usual disappearance of starch and formation of glucose. The ferment acts also when extracted by the glycerine method.[1]

PROFESSOR L. H. BAILEY in an admirable account[2] of the dewberries, shows that they arise from two species of Rubus, R. Canadensis and R. trivialis, of which the former also shows two well marked

[1] Annals of Botany v. 512.

[2] Cornell University Exper. Station, bulletin 34.

varieties, roribaccus and invisus. He calls attention again to the fact that the bush blackberry does not have any trailing forms, the so-called var. humifusus having apparently been established upon a dewberry. Apropos of this bulletin we may be permitted to remark that we know of no better model for experiment station botanists than the recent bulletins of the horticultural division of the experiment station of Cornell University.

AMONG THE BULLETINS of the experiment stations recently received are quite a number upon botanical topics. Dr. C. F. Millspaugh (W. Va., No. 19) writes on weeds, especially their value as fertilizers for the soil when suitably composted. Prof. L. H. Pammel (Iowa, No. 15) gives a very full account of the fungous diseases of the sugar beet, more particularly those caused by species of Uromyces, Cystopus, Cercospora and Rhizoctonia. Fungicides and their specific application are treated by Miss Freda Detmers and Mr. W. J. Green (Ohio, vol. IV, No. 9), Mr. E. G. Lodeman (Cornell, No. 35) and Mr. L. F. Kinney (R. I., No. 14).

THE FOLLOWING tribute is paid to Dr. Geo. L. Goodale in the last annual report of Harvard University: "The development of the botanical establishment of the University during the last ten years may fairly be called extraordinary. It has acquired a large fire-proof museum, to contain not only its collections, but its lecture-rooms and laboratories; has added greatly to its collections and its library; and, at the same time, has obtained larger permanent funds for the support of the combined establishment. Every branch of the work has been developed and enriched. For all this material progress the University is chiefly indebted to Professor George L. Goodale, Director of the Botanic Garden."

TWO NUMBERS of the new *Forstlich-naturwissenschaftliche Zeitschrift* have reached us. In typography they are somewhat disappointing, since they are printed in German type instead of Roman, a step which the majority of scientific men will consider retrogressive, no matter to what nation they belong. The contents of the two numbers is as follows: Dr. Robert Hartig, The sickening and death of pines on account of defoliation by Liparis monacha; Dr. Carl von Tubeuf, The diseases of Liparis monacha; Dr. R. Weber, On the influence of seed production upon the ash constituents and nitrogenous reserve materials of the wood of the red beech; Dr. A. Pauly, On a breeding research with Pissodes notatus; W. Eichhoff, Suggestions as the extermination of insects injurious to forests and field-crops.

MR. SPENCER LEM. MOORE shows [1] that the callus with which sieve plates of the vegetable marrow are closed at the end of the growing season is formed of proteids. The slowness with which some of the proteid reactions take place have caused observers to deny their occurrence. The behavior of the callus with neutral salt solutions and other solvents is like that of coagulated proteids. They can be removed from the sieve-plates by a peptonizing fluid, and in nature their mode of removal strongly suggests the action of a proteolytic ferment, which however has not been isolated. Mr. Moore also finds that the so-

[1] Journal of the Linnean Society xxvii. 501.

called "stoppers" of the cells in the thallus of Ballia callitricha have similar reactions to the proteid tests, except that they do not dissolve under the action of a peptonizing ferment. He considers them of proteid nature, allied to lardacein.

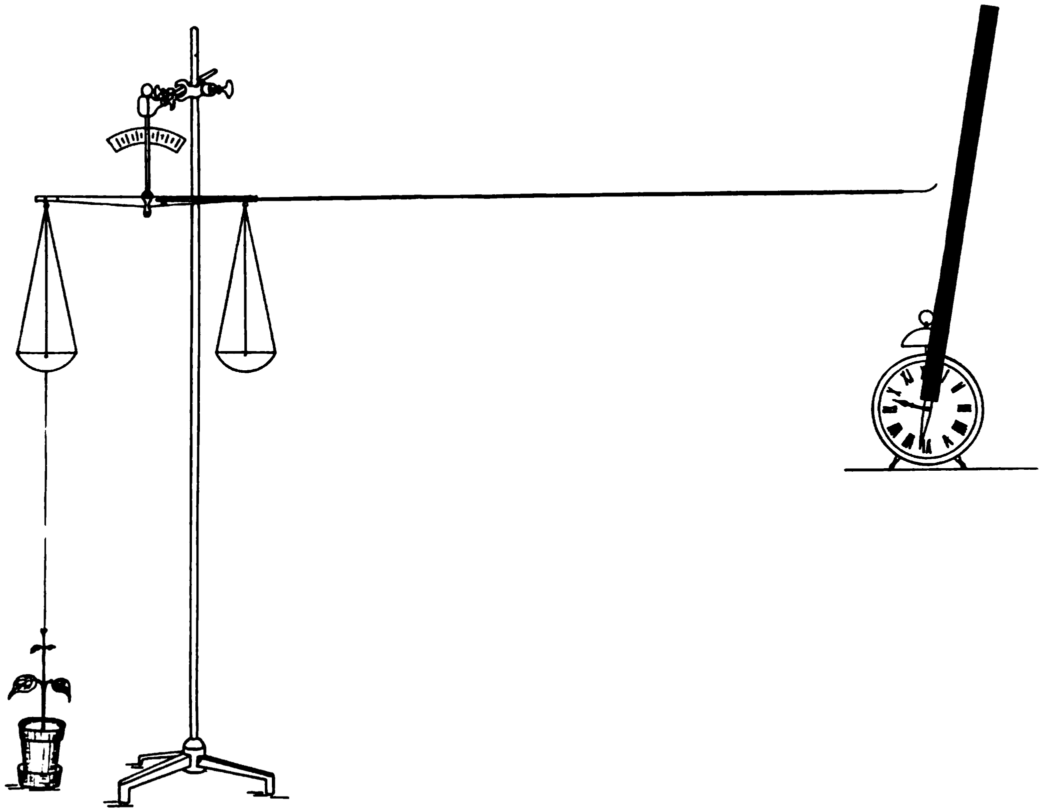
AT A RECENT meeting of the Linnean Society (Jan. 21), Mr. F. E. Weiss read a paper "On the development of the caoutchouc-containing cells of *Eucommia ulmoides*." He found that the bark and leaves of this tree, used medicinally by the Chinese, and called by them "Tu-chung," contain numerous elastic threads of silky appearance, which proved to be of the nature of caoutchouc. They are contained in long unbranching cells, somewhat like latex cells, which are found in the cortex and in the secondary phloem, and accompany in large numbers the ramifying bundles of the leaf and the pericarp. Unlike the ordinary latex cells, they are not derived from specialized cells of the embryo, but originate in all new growths, and can be seen forming in the cortex, the pith and the parenchyma surrounding the bundle of the petiole. They originate in twos, by longitudinal division of a very granular cell, both daughter cells growing out at their two extremities into a long tube, which makes its way along the intercellular spaces by sliding growth. They never contain more than one nucleus, and the large granules of caoutchouc, which soon make their appearance, finally coalesce into a single mass, which has, when the tissues are broken, the appearance of a silky thread. Mr. Weiss regards these cells as a primitive form of latex cells, similar to those from which the more elaborate ones of the ordinary Euphorbiaceæ may have been derived.—*Gard. Chron.*, Feb. 6.

A CONTRIBUTION to the detection and function of tannin is made by Moore in the seventh paper of his series: Studies in vegetable biology.[1] The summary is here reprinted:

1. Nessler's test for ammonia is a valuable aid to the botanist in detecting with certainty and rapidity the presence of tannin and tannic acids in plants. Other fluids having caustic potash for a basis are also good reagents for tannin. 2. Two chief kinds of tannin are to be distinguished according to their behavior with Nessler's fluid: (a) the iron-blueing tannin strikes brown with the fluid; (b) the iron-greening variety is turned yellow by it. 3. The yellow substance just mentioned readily diffuses through the cell wall; this effect is to be ascribed to the caustic potash, for alkaline solutions, even the weakest, will act in the same way. Here we have a provision, by the aid of rain, dew, and activity of soil organisms, for the excretion of tannin from the general surface of plants containing this form of it. 4. In addition to the functions hitherto ascribed to tannin, Haberlandt's recent discovery, with reference to the water-drop exuding on section of Mimosa pudica, renders it probable that tannic acid may have a more general relation to the turgescence of cells. Moreover, tannin is most likely used up in the lignification of the cell wall. 5. The diffusible tannin, although primarily excretory, and the non-diffusible kind when occurring in shed organs, may yet, in view of the fact that tannin can act as a source of carbon to fungi, have some indirect connection, *via* the nutrition of saprophytes, with the metabolism of green plants.

[1] Journal of the Linnean Society xxvii. 527.

THE HOMOLOGIES of the angiospermous embryo-sac and its contents always form an interesting subject for speculation. The prevalent view at present, that the embryo-sac is a macrospore and its contents a 7 or 8-celled prothallium, is not without objection; not a small one being that it in no way accounts for the conjugation of a micropylar and an antipodal nucleus to form what is known as the definitive nucleus. The formation of an 8-celled prothallium by nuclear division is perfectly clear; but the conjugation of two of these nucli is in no way explained by the ordinary view. Warming and Vesque consider that the eight nuclei produced within the embryo-sac represent two sets of four macrospores derived from two sporocytes, the embryo-sac thus becoming a special spore-mother-cell. Marshall Ward has advanced the view that the eight nuclei correspond to two 4-celled prothallia. Gustav Mann, however, in the Proc. Roy. Bot. Soc. of Edinburgh (June, 1891), who has been investigating the whole subject as exemplified by *Myosurus minimus*, has a hypothesis to suggest, which, so far as we know, is the first that has attempted to explain the double conjugation which takes place in the embryo-sac. He believes that the micropylar half of the embryo-sac corresponds to four female spores or macrospores; and the antipodal half to four male spores or microspores. Two of these eight cells conjugate, giving rise to the endosperm-cell, which must be looked upon as producing a true embryo, but which being weaker than the embryo resulting from cross-fertilization (of oosphere and pollen-nucleus), has become modified to serve as a storehouse for the stronger embryo. Such a theory would also play its part in suggesting explanations of apparent parthenogenesis and polyembryony. There is no doubt but that our views of the homologies of these parts must be modified; whether they will take the direction so ingeniously suggested by Mr. Mann is another matter.



STONE on an AUXANOMETER.

BOTANICAL GAZETTE

APRIL, 1892.

A simple self-registering auxanometer.

GEO. E. STONE.

(WITH PLATE V.)

The various forms of self-registering auxanometers used in botanical laboratories are more or less complicated and costly instruments. Such instruments as are used by Sachs, Wiesner, Baranetzky, Pfeffer, and others, vary considerably in their construction and utility. One of the best auxanometers for general purposes that has been devised is that of Baranetzky. A modified form of this apparatus is used by Pfeffer, a figure and description of which is given in his Pflanzenphysiologie.[1]

The multiplying apparatus, which, however, is the most important part of an auxanometer, consists of two grooved wheels of different radii that are fixed to a horizontal axis which revolves on delicate bearings. The large wheel has a radius of 100 mm., and the small one of usually about 12.5 mm., thus giving an enlargement of eight times; over the small wheel there passes a thread, one end of which is connected with the plant, the other to a weight of sufficient size to cause the wheel to respond freely to the movements of the plant. Each movement of the small wheel is communicated to the large wheel which supports the pen and a compensating weight. This apparatus can be used with any form of a registering cylinder; perhaps the most convenient for general purposes is the electric drum that registers in steps.

The accompanying figure shows a simple and inexpensive auxanometer used by the writer, which can be easily constructed by any one. The enlarging apparatus consists of a hand balance, such as is used in every laboratory. The arrangement is as follows: To one of the balance arms there is attached a very light though rigid straw, to the free end of the straw there is fastened, by means of sealing wax, a fine pin of spring brass

[1] See also Goodale's Physiological Botany, p. 383.

wire that serves as a pen. The end of the wire or pen is hammered out very thin, and cut with a pair of scissors to a delicate point. A length of one or two cm. near the base is also flattened to lessen the rigidity of the wire, that the point may offer much less resistance when in contact with the cylinder. It is necessary that the pen should be long and sufficiently curved, so that the straw itself does not come in contact with the cylinder.

To the other balance arm the plant is connected by means of a thread fastened to the under side of the scale. Before attaching the plant, however, enough weight is added to the left hand scale to balance the weight of the straw, after which a small weight (in our experiments .04 gm.) is added to the right hand scale to produce the proper deflection, which should be equal to at least one-half the length of the registering cylinder. The amount of deflection can be determined by a paper protractor fastened at the top of the balance. If now we have a deflection equal to one-half the length of the registering cylinder, and the balance arm be placed at a corresponding point above the horizontal position, the pen will have an amplitude of motion equal to the whole length of the cylinder. When the balance arm is in this latter position the plant is attached, and it is evident now that the tension on the thread would not be .04 gm., but .08 gm. It is desirable that the straw and pen should be exceedingly light, so as to interfere as little as possible with the sensitiveness of the balance.

Such an adaptation of the hand balance answers as a simple substitute for the more expensive multiplying appliances; moreover it possesses a greater degree of sensitiveness, although, as we have seen, the tension is not constant. For example, it may be .08 gm. in the beginning of the experiment, and only .04 gm. when the balance arm is in the horizontal position, but this variation we believe is practically unimportant with such small weights. The original apparatus of Sachs required a weight or tension of 20 gm.; that of Wiesner of 7 to 10 gm.; and the apparatus used by Pfeffer, even when compensated as fine as possible, must have a tension of 1.5 gm.; in general, however, this apparatus is used with a tension of 3 to 10 gm.

It is a well known fact that even a tension of a few grams affects the normal growth of a plant; notwithstanding this

fact, the relative growth curve produced by a large tension is correct, provided the first hourly registrations be neglected.

The registering apparatus consists of a cheap nickel clock costing seventy five cents. The minute hand is removed from its spindle and a piece of thin metal carrying the cylinder is put on instead; one end of this piece of metal is pointed and of sufficient length to answer as a substitute for the minute hand; the other end supports the cylinder and is bent outwardly, for the purpose of having the latter stand out some distance from the dial. At its point of attachment to the minute hand spindle it is considerably thickened, and the hole is made of sufficient size to allow the piece of metal to be driven on firmly. The cylinder consists of one turn of ordinary glazed paper, blackened on one side over a lamp, and having a length of about 36 cm. and a diameter of 2 cm.; it is fastened to the metal by means of soft wax. The cylinder makes a revolution once every hour, and by so doing the growth of the plant is registered by a series of parallel lines. For its successful revolution it is important that all the parts should be exceedingly light. The clock used by us was not in the least affected by the weight of the cylinder, and was capable of running 30 hours without re-winding. If, however, the cylinder is very large there is a possibility of the spindle slipping on its axis, which would prevent it from revolving. In case this should happen, or it should be desired to use even a larger cylinder, the difficulty is easily remedied by attaching a projecting rod supplied with an adjustable compensating weight to the other end of the piece of metal, so that its centre of gravity can be made to coincide with the axis of rotation; by careful compensation a weight of considerable size can be made to revolve successfully.

In a permanent apparatus a clamp provided with clips to fasten the cylinder and for the easy removing of the same from the spindle could be advantageously substituted for the piece of metal described above. If one wishes to obtain a continuous curve of growth the clock can be placed horizontally and a disk of metal be constructed so as to slip over the hour hand arbor. A cylinder of metal, wood, or even a glass-jar, covered with smoked glazed paper, or millimeter-ruled paper, can be placed upon the disk to record the growth. With millimeter-ruled paper it is necessary, of course, to substitute an ink pen for the metal one.

Suggestions on the classification of Metaphyta.

CONWAY MACMILLAN.

The sciences of botany and zoölogy are not yet sufficiently advanced, it may be, for the proposal of that system of classification which, at once comprehensive and natural, shall bind together all our ontogenetic and phylogenetic discoveries and generalizations into a harmonious and enduring structure. The season of patient toil in the acquisition of new facts in the departments of comparative morphology and embryology is not yet past; and to both the zoölogist and the botanist there is still a vast terra-incognita presenting its untried paths for the work of discovery and cartography. To indicate what seems to be a possibly fruitful line of investigation—or rather to suggest the continued investigation of an already indicated and partially explored region, from a somewhat different point of view than the ordinary one—is the object of this paper.

The bald statement that there exists a great group of living creatures with which students of biology have long been familiar, but of which there is as yet no classification, no Systema, no Tournefort or Linnaeus, and no compendium or monograph of any sort, borders closely on the sensational. From a certain point of view this is, however, a fair statement and one that can be defended. The groups to which reference is made have been studied since the time of Camerarius and properly understood since the days of Hofmeister. Their presence as organisms is nevertheless owing to the persistence of ancient habits of thought, largely overlooked by the students of to-day. The accepted classification of the plant kingdom into Protophyta and Metaphyta buries every vestige of the group, and it is only by modifying that classification that the lost-tribes may be made to emerge from their obscurity. In the briefest manner let us examine the ascertained facts of progress which are considered of importance in determining the rank of successive series of plants and animals. First and lowest in the scale of differentiation are those organisms which can not be safely grouped either with the plants or with the animals. These are the Protista of Hæckel, the third kingdom. From them as a substratum the two phyla of plants and animals arise. In each branch of the primitive trunk the lower series of organisms are devoid of sex, purely vegetative even in their reproductive functions. These are

the Protophyta and the Protozoa, or if one should apply names to indicate the physiological character upon which the groups are founded, the Agamophyta or sexless plants, and the Agamozoa or sexless animals. With such transitional forms as Ulothrix and some of the ciliated Infusoria the two higher groups of organisms are introduced and we may distinguish the sexual plants, Gamophyta, from the sexual animals, Gamozoa. This latter branch is almost equivalent to the Metazoa, but the Gamophyta as here limited constitute but a small portion of the organisms which are included as Metaphyta. It is precisely here that the great hiatus between our classification of plants and animals is to be discerned. To appreciate properly the true condition of things is perhaps more easy if we divide the Metazoa and Metaphyta, respectively, into two co-ordinate groups. This is a division of organisms, not of species, and can be performed, I think, without violence to right thinking. There may be distinguished, then, in the plant phylum the Sporophyta and the Gamophyta, and in the animal phylum the Sporozoa and Gamozoa. A sporophytic or sporozoic organism might be defined briefly as one that develops primarily from a segmentation-cell (fertilized egg, parthenogetic egg or vegetatively apogamous cell) and normally forms in turn perfect reproductive cells or *spores*. In the plant phylum this group includes a most diverse and numerous series of organisms, from the four-zoospore-plant of Œdogonium to the moss-capsule, the ferns, club-mosses, pines, cycads, and all the herbs, shrubs and trees with which we are familiar. In the animal phylum, however, the Sporozoa would include only a very few and relatively insignificant organisms, chiefly among the Cœlenterata, and doubtfully extending among the Tunicata; that depending upon whether the views of Brooks or of his critics are to be accepted concerning the homologies of the salpa-chain.

With the division of the two branches, Metaphyta and Metazoa, it becomes apparent why the coördination of plants and animals under any of the systems is so unproductive of the most valuable systematic or philosophical results. We do not compare, habitually, the Sporophyta with the Sporozoa, but with the Gamozoa, thus missing the chance of determining the true parallelisms and homologies, if any exist. That sporophytic structures may not be compared (except physiologically) with gamophytic has already been shown by

Bower,[1] but it does not seem to be out of place to insist here that such structures and organisms are even less aptly compared with the Gamozoa.

It will be recognized as of high importance to discriminate in the two divergent phyla of plants and animals the truly double and parallel composition of each of the upper series. And, since the structural development in the two phyla varies reciprocally, it is not possible to compare them without clearly perceiving the double nature of each. For in the Metaphyta the sexual series has undergone progressive structural degeneration from the mosses to the highest of the Siphonogama, while in the Metazoa the sexual series manifests increasing complexity from the lowest Cœlenterata to the Primates. On the other hand, in the plant phylum, sporophytic organisms from the Œdogoniæ to the highest Metachlamydeæ show a constantly increasing structural differentiation; but in the animal phylum, sporozoan organisms are developed only low down in the scale and are discontinued long before the higher classes are reached. I have already indicated elsewhere what may be the reason for this remarkable difference between the two kingdoms[2], and it will suffice to suggest that the relatively great immobility of gamete-producing, that is sexual, plants is the primary cause of their defeat in the struggle for food, sunlight and organization with the more capable sporophytes. This supremacy of the sporophytes is so complete that all the higher gamophytic plants have been forced into a most abject condition of parasitism upon the sporophytic structures of their own species.

The great mass of the species grouped in the Metaphyta are, therefore, persistently and strongly dimorphic, and it is this dimorphism which distinguishes the plant from the animal phylum. The essential diagnostic character of the Metaphyta might be described, indeed, as sharply defined specific dimorphism. While the higher animals may, for each species, be separated into two groups of organisms differing only in sex, the higher plants may, for each species, be divided into perhaps four groups or organisms, viz., the pollen-bearing, the pistil-bearing, the male (pollen-tube) and the female (embryo-sac contents). This conception of the plant

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[1] Bower: Antithetic and Homologous Alternation; Ann. of Bot. IV, 347–370, 1890.

[2] MacMillan: Amer. Nat. XXV, 22—25, 1891.

species is of course rendered difficult by the as yet uneradicated error of considering pollen-tube and embryo-sac contents in the light of organs belonging to the sporophytic forms of the species. I have had occasion before, in these pages,[3] to call attention to the wellnigh hopeless confusion of botanical terminology in this region of the science. When Goebel speaks of the fertilized macrospore of Pilularia being attached to the ground by its prothallial rhizoids[4], or when Müller entitles a work "The Fertilization of Flowers," in which *fertilization* is not even mentioned, it serves to illustrate how deeply rooted is the fault of nomenclature which perpetuates the ancient errors of Camerarius, Linnæus, Sprengel and Erasmus Darwin.

It is clear that there must still be much study before botanists can hope to define their species correctly, to say nothing of grouping them in an enlightened manner. The emancipated zoölogists of the day are accustomed, with an air not unfamiliar, to deprecate the attention bestowed upon classification and systematic work by the botanists. They do not, perhaps, discern that in a way the problems of the botanist are two-fold as complex as their own, just as the organisms with which the botanist has to do are doubly complicated. Up to this time so little material has been examined that there are very few species of Gamophyta accurately described. It is inconceivable that there should not exist differences between the male plants of Salix and Populus, for example, in some way related to the differences between the sporophytes. What these differences are is a task for future investigation. It may be many years before the *Genera Plantarum* or the *Histoire des Plantes* of the higher Gamophyta is written; but such a work is imperative before it can be pretended that we are in a position to fitly describe or classify the plant phylum in a final manner.

The evolution of sporophytic structures in the plant kingdom is so considerable that certain divisions should be noted in their development if they are to be set off against the far less important and less highly evolved group of the Sporozoa. Otherwise a wrong impression will be given in the comparison. With this in view it may be advisable to recognize in

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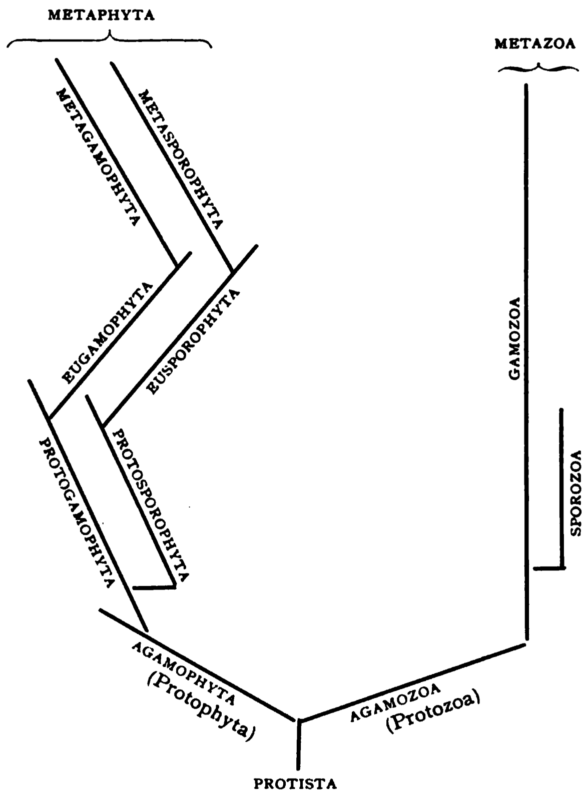
[3]Bot. Gazette, XVI, 178, 1891.

[4]Goebel: Outlines of Classification and Special Morphology, Eng. tran., 243.

both the Sporophyta and the Gamophyta three fairly well-marked physiological divisions: first, the lowest Sporophyta are included in the gametophytic body and are therefore parasitic upon the sexual plant, e. g., Œdogonium, Chara, Riccia. Second, the higher forms are self-supporting and do not nurse the gametophytes, e. g., the higher mosses, the lower fernworts and club-mosses. Third, the highest forms act as host-plants for dependent, symbiotic gametophytes and



are so specialized, e. g., the seed-plants and the higher fern-worts and club-mosses. These groups might be named respectively the Protosporophyta, Eusporophyta, and Meta-sporophyta, in order to facilitate reference without paraphrasing. Similarly, the lowest Gamophyta do not furnish nutriment for sporophytic structures of their own species, e. g., Ulo-

thrix, Fucus, Peronospora. The higher support dependent sporophytes, e. g., Œdogonium, Marchantia, Sphagnum. The highest are symbiotically parasitic upon sporophytic structures of their own species, e. g., the Isoetineæ, Selaginelleæ and Siphonogama. These might be named respectively the Protogamophyta, Eugamophyta, and Metagamophyta. It is this last division that constitutes the principal part of the unexplored region. The accompanying diagram indicates the grouping of living things here suggested.

University of Minnesota, Minneapolis.

Some fungi common to wild and cultivated plants.

BYRON D. HALSTED.

Reference is here made to the relation of the fungous parasites of wild plants, including weeds, to our crops whether of fruit, grains, or vegetables. This deleterious influence can best be brought out by taking up some of the worst fungous enemies to crops and showing the range of these parasites upon the surrounding wild plants.

Starting with the garden vegetables it is easy to find illustrations on every hand. Thus the lettuce mildew, *Bremia Lactucæ* Reg. is found up to date upon no less than forty-one species of plants belonging to the same family as lettuce and closely related to it. Many of these hosts for the mildew are common garden weeds and others inhabit the uncultivated ground.

The celery rust, *Cercospora Apii* Fr. now so destructive with truckers, is common to the carrot and parsnip also, and as the wild form of these abound without stint in many localities we need not wonder that the garden plants are partially destroyed by this pest.

There is a mildew of the spinach, *Peronospora effusa* Gr. that flourishes upon the pigweeds generally, there being no less than ten of these weeds that are thus infested and furnish a propagating place for the mildew of their patrician cousin grown on a salad plant.

The bean rust, *Uromyces appendiculatus* (P.) is one among a conspicuously destructive group of fungi that makes its home upon several species of wild beans.

But of wider range than any species yet mentioned is the mildew of the pea, *Erysiphe Martii* Lev. which renders it almost impossible to grow late peas. This fungus preys upon plants of at least six large and quite widely separated families and therefore in any neighborhood may have ample means at hand for keeping up its abundant stock of specimens.

The mildew of the cabbage and turnip, *Peronospora parasitica* (P.) is not an unmixed evil however, for because of its wide range it attacks the shepherd's purse, various mustards, and a number of other weeds. The hosts enumerated in a list recently consulted were thirty-five, and most of these are common plants in all parts of our country. Another fungous disease of the cabbageand turnip, namely, the club root, *Plasmodiophora Brassicæ* W. while as yet not recorded outside of these two hosts and the radish, very likely is at home with many of the other plants of the same order, but root diseases being out of sight are not easily found unless specially looked for.

Coming to the fruits and beginning with the lowest in stature, the cranberry, we see a fine instance of the question in hand in the gall fungus, *Synchytrium Vaccinii* Th. The following, mostly small shrubs growing along the shore or border of the bog, are afflicted with the same disease: azalea, sheep laurel, white alder, leather-leaf, huckleberry, and wintergreen. While these plants are members of the same family, they all differ considerably from each other and from the cranberry. It is evident that any remedy applied to be effective would need to include the infested shore shrubs.

The strawberry blight, *Sphærella Fragariæ* (Tul.) is met with upon wild vines of both our common species.

Sphærotheca Mors-Uvæ (Sch.) producing the gooseberry mildew and crippling an industry in this country, is found upon several species of our wild gooseberries. The writer recalls collecting fruit and young twigs entirely covered with the thick brown felt in the cañons of Colorado, where there were no cultivated bushes perhaps within five hundred miles. In like manner the anthracnose, *Glœosporium Ribis* (Lib.) that causes the premature dropping of foliage, is common to several species of currant.

The blackberry rust, *Cæoma nitens* (Sch.) is an especially important illustration of the relationship of wild plants to those close of kin that are cultivated in the garden. This conspicu-

ous rust grows upon the low blackberry, dwarf raspberry, thimbleberry, wild red raspberry, high blackberry, and sand blackberry. In a trip through the Carolinas in May last, this orange colored fungus was to be seen at nearly all times from the car window and one could but pity the cultivated species of Rubus, were there any grown in that afflicted region.

The diseases of the grape and in particular the mildew, *Plasmopara viticola* (B. & C.) are in general common to all wild species of the vine. The worst specimens I ever found were those of a wild plant in Iowa, many miles from any cultivated vines and the mildew was so bad upon the canes as to dwarf them to a few inches in length while they were covered from one end to the other with the white down of the fungus. Not only the *Vitis æstivalis*, *V. Labrusca*, *V. vinifera*, *V. riparia* and *V. Californica* are infested, but likewise the closely related Virginian creeper and more recently the Boston ivy are victims.

Among the plums and cherries we find four parasitic fungi to interest us in this connection, for they abundantly illustrate the fact of the close relationship of wild with our cultivated plants. First the plum pockets, *Exoascus Pruni* (Fcl.) are familiar to all as peculiar distortions of the fruit and stems of the cultivated plum, dwarf cherry, bird cherry, choke cherry, and some other species of the genus Prunus. The peach curl, *Exoascus deformans* (Berk.) also infests the dwarf almond, common garden plum, and three kinds of cherries, besides the peach. There is a rust, *Puccinia Pruni* Pers. which is very destructive in some parts of the country particularly to the peach and apricot in California. No less than ten species of the genus Prunus are subject to attacks from this enemy and the list includes the peach, apricot, plum and cherry, several of the last two being wild trees or shrubs.

Last but not least for the genus Prunus is the black knot, *Plowrightia morbosa* Sacc. As this enemy is of great magnitude it merits the naming here of the eight species that are subject to attack; namely, the Chickasaw plum, *P. Chicasa* Michx.; the beach plum, *P. maritima* Wang., a thorny shrub on the sandy sea-shore; the wild yellow plum, *P. Americana* Marsh., a shrub or small tree along streams. Of the cherries, the choke cherry, *P. Virginiana* L., a small tree, is most frequently infested; but the wild black cherry, *P. serotina* Ehrh.,

a tree of the hedge rows, and the wild red cherry, *P. Pennsylvanica*, are also attacked.

It is evident from the illustrations that have been given of the diseases of the genus Prunus that there must be a close relation existing between the wild plants and those grown for fruit. What with the plum pockets, the curl, rust, and black-knot, it is evident that more attention needs to be paid to the wild hosts of fungi of cultivated plants before the latter can be free from their attacks of their present enemies.

There is a mildew, *Podosphæra tridactyla* (Wallr.) so wide-spread that it cannot be assigned to any one crop. Because very destructive upon the apple and particularly seedlings in the nursery it has been called the apple leaf mildew, but in some localities cherries, both old and young, suffer severely from it. It preys upon the quince, several species of the hawthorn, the June berry and various spireas. It seems to be a well established fact that plants that are closely related are quite apt to be subject to the same fungous enemies. But it does not follow that plants not near of kin will not have parasites in common. For example, within the past year it has been fully shown that bitter rot or ripe rot of the apple fruit is the same fungus that causes one of the dreaded decays of grapes. In like manner at the New Jersey experiment station it has been found that one of the worst enemies to the sweet potato is identical with a serious disease of egg plants. There seems little in common between the sweet potato and the egg plant and yet in the face of the fact of a common enemy it may suggest the importance of not following one crop by the other in those localities where they are both grown prominently and one or both are already more or less diseased.

In like manner it has been shown that a bacterial disease of the potato also affects the tomato and *vice versa*; and that was to be expected as both hosts are closely related; but that one disastrous form of melon blight is due to the same cause was unexpected because of the lack of kinship between melons and potatoes. The inference was that if melons were attacked cucumbers and squashes would also be. This was shown to be true and before the season was through it was found that much damage to the cucurbits generally was due to the bacterial disease.

Space forbids even the briefest mention of many other cases where plants wild affect the health of plants cultivated

by being the means of supply of fungus germs. One other instance that illustrates a phase of our subject not before touched upon may be given. The plant is a familiar one to many and painfully so to not a few. This is the apple rust (*Ræstelia*) that yellows the foliage of the orchard in July and shortens the crop at picking time. This fungus plays a double role and seems unable to get along with the apple tree alone. In a second and very different form, *Gymnosporangium*, it infests the cedar trees, there forming knots or galls that become conspicuous as gelatinous balls during the spring rains. These orange colored balls furnish the spores, which falling upon the foliage and fruit of the apple tree, produce the fatal rust. Later in the season the spores from the apple fungus go back, upon the wings of the wind, to the cedar and a new crop of galls is obtained for next spring's campaign against the orchard. In this case it is not wild apple trees or those of the same family that harbor the enemy, but a tree as widely separated botanically from the apple as is well possible. More than this, the fungus changes its form in passing from one to the other so that it was not until demonstrated by actual cultures that the relation, long suspected, could be fully believed. It is needless to say that the very evident method of procedure is to destroy cedar trees that are anywhere near the apple orchard. A single large gall-bearing cedar tree just outside the orchard fence may do more mischief than any enemy that is lurking within the enclosure.

It has been shown by means of a long series of examples that the evil influences of wild plants may act at long range. It is not necessary that their roots and those of the cultivated plants hould cross each other's paths in the soil or that their branches should interlock and overshadow one another in a deadly embrace. There is a more subtle bad influence than gross thieving or clutching by the throat. It is more in the nature of a poison that is sent out upon the air to be breathed in by the innocent wherever they may unwittingly meet the unseen but deadly germs.

Crowding of plants is bad, rank growth of weeds is worse, but the most fatal of all influences is that unseen group that steal away the health of the plants which lack nothing for room and enjoy high and thorough culture.

After all it is the host of enemies that swarm from the

plants outside the garden fence that try the patience of the husbandman. He has learned the methods of remedying the others, but the floating spores defy his keenest eyesight to discern and baffle his ingenuity to combat. The ways of the fungi are however being slowly and laboriously revealed by the microscope and conquered by the spraying pump. The former assists the latter, which as yet somewhat blindly fires effective "small shot" into the enemies ranks.

Proper seeding, fertilizing, and weeding will do much to assist, in warding off the deleterious influences of fungous enemies for healthy plants, while not proof against their attacks, are less liable to be overcome by them. Let therefore everything be done that is possible before the last resort comes and then the fungicide will have the greatest effect and yield the most returns. If so much of the smut, rust, mildew, mold, rot, and blight of our cultivated plants is propagated by the wild plants hard by, it may be wise for every crop grower to pay attention to what is thriving outside his garden wall. He cannot build it high enough to shut out the spores, but he can do much to diminish the number of these spores. Having done this, he can take up the spraying pump with a brighter hope of future success. There was a carcass, so to speak, in the pasture and he went out and buried it. Fungi are the basis of contagion and they infect at long range by means of their myriads of invisible spores. To learn of their ways and find better methods of resisting them make the burden of many a station botanist's labor today.

Rutgers College, New Brunswick, N.J.

Noteworthy anatomical and physiological researches.

The stem and leaf of the mosses.[1]

After alluding briefly to the principal works on the subject of his research, the author takes up the study of the anatomy of the aerial stem of mosses, distinguishing four types.

I. With uniform parenchyma containing chlorophyll bounded by: 1. A zone of aquatic cells; 1st type, Sphagnum. 2. An epidermal layer; 2d type, Thuidium.

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[1] BASTIT, EUGENE: — Recherches anatomiques et physiologiques sur la tige et la feuille des mousses. Revue général de botanique. III (1891.). pp. 255, 306, 341, 373, 406, 462, 561.

II. With parenchyma differentiated into a central cylinder and parenchyma containing chlorophyll. 1. Central cylinder uniform; 3d type, Mnium. 2. Central cylinder differentiated into a medullary region and a surrounding pericyclic zone; 4th type, Polytrichum.

In using the term "pericyclic zone," the author remarks that "as to its development, it is not comparable to the pericycle of the phanerogams, and in general, a strict analogy cannot be established between the tissues of the stem of the mosses, a product of the asexual spore, and the stem of the higher plants, a product of the egg."

From this pericycle and central pith arise the leaf traces, which diverge from the center according to a law constant for each species. The trace reaches its maximum differentiation at the periphery of the stem as it passes into the leaf costa.

In mosses with a central cylinder, branch traces are found arising by differentiation of the medullary tissue and the pericyclic zone. Here, also, the traces follow a law of divergence constant for each species.

For his study of the leaf the author uses *Polytrichum juniperinum.* He regards the chlorophyllose lamellæ as an assimilative tissue and "from analogy, comparable to the palisade cells of phanerogams."

The subterranean stem of Polytrichum juniperinum is worked out with very interesting results. The outline in cross section is bluntly (tri)angular, and instead of the concentric arrangement seen in the aerial stem, the tissues are grouped radially into three sets of structures. In the apex of each angle, adjacent to the epidermis, is a hypoderm bundle, bounded on the inside by the hypoderm sector. This structure, being more extensive at the periphery than the bundle, is adjacent to the epidermis laterally for some distance, and narrows rapidly toward the center forming a rude Y which includes the hypoderm bundle between its forks. In contact with the inner end of the stem of this Y is the crescentic pericyclic sector, placed with its concavity outward and transverse to the stem of the Y. Bounding this sector, along its convex inner surface, is the central pith. Filling the spaces along the sides of the (tri)angular section are the three isolated cortical regions extending from the epidermis to the central pith.

In *Dawsonia superba*, a new Zealand relative of Polytrichum, instead of a single hypoderm bundle, there are generally three arranged radially, increasing in differentiation as they approach the exterior. The origin of the hypoderm bundles is thus plain. Their first elements arise by differentiation of cells of the pericyclic sector, *i. e.*, the bundles are of internal origin. The remaining elements are added from the hypoderm by the differentiation of its cells.

The relation of the peculiar triangular radial symmetry of the subterranean stem to the circular symmetry of the aerial stem is worked out and the transition described. The sectors and bundles of the angles extend laterally until adjacent ends meet and at the same time the radial extension diminishes, thus gradually bringing the radial arrangement into the concentric.

The more important physiological results are here summarized.

When an aerial moss (Polytrichum juniperinum was used) is subjected to an aquatic life, the epidermal layer of the stem and leaf is profoundly modified. The size of the cells is enlarged, the cuticle disappears and the slightly thickened walls retain a cellulose nature. The leaf loses its chlorophyllose lamellæ, the limb is reduced and the form slightly modified.

If the mosses are grown in air or in water, and the conditions of light and the orientation of the stem are varied, the stems are found to be very feebly negatively geotropic, and strongly positively heliotropic. Heliotropism is always predominant, and young shoots always grow toward the light whatever be their position.

Under the influence of humidity of the air, the leaves of certain mosses take two positions upon the stem: one corresponds to the hygrometric state approaching saturation, the position of expansion; the other, to a state approaching dryness, the closed position. In passing from the open to the closed position or *vice versa*, the leaf executes movements in both longitudinal and transverse directions. The movements begin in the leaves at the base of the stem, and extend gradually to those at the summit. The cause of the movements is found in the contraction aud the turgescence of the cellulose membranes of the leaf.

In both the open and the closed condition mosses respire in darkness, evolving CO_2 and absorbing O; the relation be-

tween their volumes remaining constant between 17° C. and 20° C. As regards the respiratory function, then, the mosses come into the general case of chlorophyll-containing plants. In the closed condition, the activity of the chlorophyll function (assimilation) diminishes nearly 50 per cent. The activity of both respiration and chlorophylline assimilation abates as the moss becomes dry. The inference may be made that these functions slacken during the summer with the mosses. It is in spring and autumn, when they are continually moist, that they elaborate nutritive materials most actively. This explains the appearance of the sporogonia during these seasons in so large a number of species.—RODNEY H. TRUE.

Anatomy of the stolons of Gramineæ.[1]

Although the function of the stolons in the Gramineæ is nearly the same, being at once reservoirs of nutritive matters and organs in the service of the vegetative propagation, the author has observed several differences in the interior structure. And he claims at the same time, that the two general types of stolons, which have been proposed by another author, Mr. Johanson,[2] are not sufficient, when the question is to characterize the structure of these organs in general. The two types mentioned by Mr. Johanson were distinguished by the different arrangement of the mechanical tissue, which is either central with a large cortex in contrast to a reduced pith, or nearly subepidermal with a large pith and a reduced cortex. But the author enumerates now several other anatomical features, observed in stolons of different genera, which occur under different conditions. He shows from the numerous intergradations between the stolons under-ground and the shoots above-ground, that the organization of the stolon depends upon a modification of the above-ground shoot. The structure of the shoot above-ground is well marked by the position of the mechanical tissue, which is either truly subepidermal or more or less distinctly subcortical, the bark being as a rule not very strongly developed. But there is a large series of modifications between this form and those derived from such shoots as show a tendency to replace stolons.

[1] P. HELLSTRŒM: Naagra iakttagelser angaaende anatomien hos græsens underjordiska utlöpare. Bihang Kgl. Sv. Vetensk. Akad. Hdlgr. vol. XVI, no. 3, Stockholm, 1891.

[2] Kgl. Sv. Vetensk. Akad. Hdlgr. vol. XXIII, no. 2, p. 30.

There is also given an account of the structure of the scale-like leaves, which cover the stems under-ground. These consist of a strongly mechanical tissue, which encloses the mestome-bundles, which here often contain a mere leptome. This, as it seems, peculiar fact is, however, easily explained, since the function of such leaves is not assimilatory; they do not need, therefore, the elements of the hadrome, but merely the leptome, for the supply of already prepared organic matters. The function of the strongly developed stereome in these leaves is not only to protect the leptome, but also to form a kind of support to the entire stolon.

As regards the endodermis, the author states several variations in the stolons, which he has examined, and which he refers to two groups: the so-called **O**-endodermis, the cells of which are thickened equally all around, while in the second one, the **C**-endodermis, it is merely the inner and the radial walls in which a thickening has taken place. A double endodermis was observed in some species of Triticum, Calamagrostis and others. (The writer takes here the opportunity to call attention to similar studies upon our native grasses, in which the vegetative propagation is so strongly predominant, and which might give still more extended illustration of the characters enumerated above.)—THEO. HOLM.

Studies upon germination.[1]

In a recent paper[1], Hildebrand describes the germinating plantlet of *Cecropia peltata* upon which he has observed a long series of different forms of leaves, from ovate to cordate, gradually succeeded by peltately three or five-lobed leaves until finally the typical form appears in the nine-lobed leaf. He shows also the gradual development of the "domatia" at the base of the petioles, in which the protecting ants take up their residence and feed upon a certain kind of exudation. These domatia are not present, however, at the very earliest stage of the plantlet, and the plant is therefore forced to provide another kind of protection against the climbing, leaf-eating ants. This is done by short branches developing from the lower leaves, having merely two sessile stipules, which are bent downwards and thereby prevent the animals from climbing the stem. It is only when about the twentieth leaf is de-

[1] Fr. Hildebrand: Einige Beobachtungen an Keimlingen und Stecklingen. Botan. Zeitung, 1892, Nos. 1, 2 and 3.

veloped that the stem has attained a sufficient thickness to give shelter to the protecting ants and to produce the exudation. The author has also observed a similar fact concerning the protection of ants in *Acacia cornigera.*

Another interesting fact, to which the author calls attention, is the difference in germination of closely related species. It is especially striking in the genus *Anemone*, and the more if we include the subgenera *Pulsatilla* and *Hepatica.* In *Anemone nemorosa*, for instance, the cotyledons are underground, and the first leaf is three-lobed; in *A. blanda* the petioles of the cotyledons are connate so as to form a long tube above ground, as also in *A. narcissiflora.* On the other hand the cotyledons of *A. fulgens* are above ground and normally with separated petioles, while some specimens differed by the partly, or in some cases even completely, connate petioles, as in *A. blanda.* In these species the plumule was kept under-ground, and it is now interesting to see, that in *Hepatica triloba* the plumule is above-ground, the cotyledons free, but here the first developed leaf is scale-like so as to protect the plumule in the first year. In some instances this scale-like leaf was replaced by a small three-lobed or reniform one. *Hepatica angulosa* germinates in the same manner as *Hepatica triloba*, while *Pulsatilla vulgaris* and *P. pratensis* differ from the other ones by having the plumule above ground with the first developed leaves of normal shape. The author describes also the germination of some species of *Dentaria*, which show similar differences.

That the shape of the leaves may depend on certain external causes is shown by *Oxalis rubella* and *Asarum.* In Oxalis the first leaf after the cotydedons is quinate, while the following is fleshy and scale-like; but when the first leaf is cut off the succeeding one attains its quinate shape instead of being scale-like. Asarum develops some scale-like leaves immediately after the cotyledons, and the author shows that by cutting off the blades of the cotyledons, some specimens of Asarum developed two small nearly normal leaves instead of the scale-like ones.—THEO. HOLM.

BRIEFER ARTICLES.

The identity of Asclepias stenophylla and Acerates auriculata.— The Synoptical Flora pertinently suggests the close relationship of these two supposed species. Under Acerates auriculata it is even stated that "unless the characters [i. e. of the two genera] are noted, it is very likely to be confounded with Asclepias stenophylla." Even so; for the two plants look to the naked eye exactly alike.

There was, in Mr. M. A. Carleton's collection of last season in Indian Territory, a plant, no. 248, which is a good Asclepias stenophylla, having all the characters of Dr. Gray's subgenus NOTHACERATES. The hoods, however, on comparison with those from herbarium specimens, were found to be longer, more compressed and more deeply notched on the back than usual, and the asclepiadaceous horn, reaching only a little above the sinus of the hood, was not at once found. This and the cautions in the Synoptical Flora led me to examine closely into the structure of anthers and hoods of all the specimens in the National Herbarium standing under the two above names, with the following result.

First, *Aclepias stenophylla* Gray is represented by three correctly named specimens in flower: one from Dorchester, Mo., collected by J. W. Blankinship; the second from Miami Co., Kansas, collected by Dr. J. H. Oyster; the third from Huachuca Mts., S. Arizona, collected by J. G. Lemmon. Mr. Carleton's no. 248 makes the fourth specimen. Nos. 1 and 2 agree with Carleton's plant in the compressed hoods and notched anther wings, but both have longer horns than the Indian Territory plant, while Lemmon's plant has both the notches in the anther wings and the sinus in the back of the hood very slight, and the horn shorter.

Second, *Acerates auriculata* Engelm. is represented by (1) an Arizona plant, Dr. Palmer's no. 604; (2) a plant collected on the Mexican Boundary Survey under Maj. Emory; (3) Wright's no. 552; (4) Wright's no. 1687. Of these, Palmer's plant has the anthers decidedly notched as in Asclepias stenophylla. The crest in the hood is present as in the first species, and reaches nearly to the sinus, but is not surmounted by any horn. In no. 2 there is still a trace of a notch in the anther wing. The crest in the hood is present, reaching over more than half its length. Nos. 3 and 4 have the crest likewise *present*, but the anther wings are merely rounded. They are however fully as wide near the base as near the top, if not wider.

From these observations, and especially when we take into consideration the long acknowledged fact that these two supposed species of

different genera are *exactly* alike in outward appearance, we cannot escape the conclusion that, in fact as in appearance, we have only *one* species. In every case of reputed Acerates auriculata crests have been found. The wings of the anthers too have been found to be, if not "decidedly auriculate," at least "dilated," certainly not "tapering at base." All of which characters bring these specimens under Asclepias, § NOTHACERATES, provided we allow the following modification of this subgenus.

§ 3. NOTHACERATES. *Anther wings moreor less widening to the rounded base, which may or may not be notched or auricled; hood sessile, its apex emarginate or more deeply notched, with a narrow, wholly adnate, internal crest which may terminate above the middle of the hood without a horn, or may be more or less prolonged into a proper horn.*

The projection of this horn above the base of the hood-sinus gives the tridentate appearance mentioned in both the description of *Acerates angustifolia* Decaisne, and that of *A. auriculata* Engelm. I quote, the first from DC. Prodr. VIII, 522: "cucullis gynostegio sublongioribus, apice tridentatis"; the second from Bot. Mex. Bound. 160: "cucullis gynostegio globoso sessili brevioribus apice leviter tridentatis." And as for the stated discrepancy of relative length of anther-mass and hoods, and of the notch in the apex of the hoods, I have, in the material examined, observed all degrees of variation.

The different names of this species, with dates, are as follows:

Polyotus angustifolius Nutt., Trans. Am. Phil. Soc., Ser. 2, v. 201, (1837).

Acerates angustifolia Decaisne, DC. Prodr. VIII, 522, (1844).

Acerates auriculata Engelm. Bot. Mex. Bound. 160, (1859).

Asclepias stenophylla Gray, Proc. Am. Acad. XII, 72, (1876).

There is another species named *Asclepias angustifolia* Ell., Sk. I, 325, (1821). So the specific name of Nuttall and Decaisne is not avail able. Engelmann's being the next oldest specific name, this species, it appears, should be named **Asclepias auriculata** (Engelm.).

Since writing the above note there has been found in a collection from Nebraska a plant that represents the Acerates side of this species, i. e., with the hoods destitute of horns, but the rudimentary crests present. This is an interesting find, as it makes the two forms practically co-extensive, at least in their northern range.—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

Bartram's Oak.—A long interval has elapsed since the Bartram oak was first made known and still its status has not been satisfactorily determined. Some contend that it is a hybrid. As the oak in question has been found at widely separated localities, although limited to a narrow

range extending from New York to North Carolina (and perhaps beyond this), one might suppose that this fact alone would be deemed sufficient to exclude the theory of hybridity in this case.

Within the last thirty years I have had the opportunity of observing it at different localities in Delaware and New Jersey and am now led to the conclusion that it is a variety of *Quercus imbricaria* Michx., of which we have here two forms, one with entire leaves, the other with lobed ones. On a single specimen, an oak growing in the Bartram Gardens on the banks of the Schuylkill at Philadelphia, Michaux founded his *Quercus heterophylla*. After describing it he remarks: "I was at first disposed to consider this tree as a variety of the laurel oak [meaning Quercus imbricaria] to which it bears the greatest affinity; but the leaves of that species are never indented, and not a stock of it exists within a hundred miles of Philadelphia." It is a tribute to the sagacity of this eminent botanist that, with only the lobe-leaved form before him, he had at that time so clearly discerned the affinity of this oak with Quercus imbricaria.

The evidence of this affinity may be seen when we compare (what is here taken to be) the entire-leaved form with the type and the lobe-leaved form of its variety. If further observation should confirm the conclusions here reached, and I believe that it will, it will then be proper to designate this oak by the name:

Quercus imbricaria Michx., var. *heterophylla* (Michx.).

a. ——— entire-leaved form.

b. ——— lobe-leaved form=Quercus heterophylla Michx.

In 1882 I found an oak in Salem Co., New Jersey, with entire leaves. Specimens from this tree were sent to Dr. Britton, who referred it to his *Quercus Rudkini* (Catalogue of New Jersey plants, p. 223). When first discovered I noticed some features characteristic of the Bartram oak to which I was inclined to refer it at the time. Later observations have now convinced me that it is the entire-leaved form of it mentioned above.

After some hesitation these views are presented in the belief that further investigation will confirm the conclusion here reached and decide a long pending question, the status of the Bartram oak.—A. Commons, *Wilmington, Del.*

The spines of Cenchrus tribuloides L.— It is a well known fact, at least to those who have carelessly handled the vile weed, that the wounds caused by the spines of the involucre of Cenchrus tribuloides are unusually painful and long continued. Personal experience in this regard led me to believe that there were some points about these spines that other spines did not possess and with a view to their

determination an investigation of their minute structure was undertaken. Under a low magnification a mature spine presents the appearance represented in fig. 1. Barbs of various sizes and, for the most part, uniform in shape are disposed irregularly over its surface, being more numerous and larger near the point, the tip of which is well supplied with them. The interior tissue of the spine (fig. 3) is made up wholly of very thick-walled cells, the thickening in many cases being of such an extent as to entirely obliterate the cavity. From the base to near the point of the spine throughout this tissue occur air cavities of different lengths but of nearly uniform width (fig. 1, *a*).

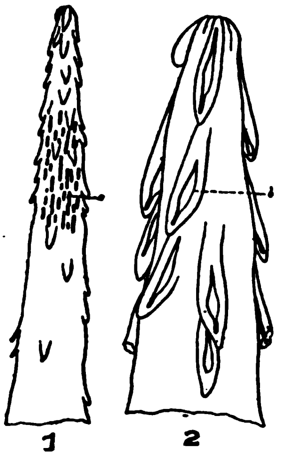

FIG. 1 and 2.—Spines of the fruit of *Cenchrus tribuloides*: 1, somewhat magnified; *a* cavities inside the spine; 2, end of the spine more magnified, *b* cavity of the barb.

When examined under a higher magnification the true nature of the spine makes its appearance (fig. 2). Each barb is seen to have within it a cavity terminating, in the direction of the point, in a narrow tube and to be filled with a substance which in color is light purple. This, in all probability, is of a highly irritating nature and, it may be assumed, is the direct cause of the inflammation of the wound. The barb itself, or at least its point, is of very delicate texture, almost hyaline and is easily broken off; when this occurs the contents of the cavity are free to escape. The cavity seems to have no connection, in the mature barb, with the interior tissue. Neither does there appear to be any means by which the contents of the cavity may be ejected. Consequently they would escape slowly— ooze out — which would account for the prolonged irritation of the wound.—E.E. GAYLE, *Lieut. U.S. A.*

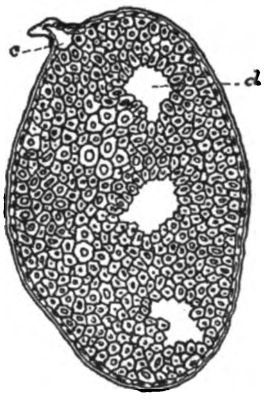

FIG. 3.—Cross section of spine: *c* section of a barb, *d* air cavity.

EDITORIAL.

BOTANISTS ARE a peaceable folk, so peaceable, we are almost inclined to add, as to be apathetic. They seem so averse to anything that has even the semblance of discussion that they will not even express an opinion lest it lead to controversy. If induction is worth anything we can substantiate this by adducing a host of facts on which it is based.

ONE HAS only to look back over the file of the GAZETTE to find that in the past five years there have been suggested numerous questions and movements,some of them of great interest to botanists. These the GAZETTE has presented, sometimes editorially, sometimes through its "Open Letters," and regarding some it has invited and even urged discussion for the guidance of those having the matters in charge. We cannot at this writing recall a single response to these invitations!

NEARLY TWO YEARS AGO the subject of a world's congress of botanists was broached in these pages and we endeavored to find out what our readers thought of the project, its desirability and its feasibility. Several other editorials have appealed for the same information but up to date not a line has come to us touching this matter. The world's congress auxiliary of the Columbian Exposition has now taken it up and proposes to have a botanical congress whether or no. The ideas of the management regarding this particular department are necessarily very general and crude, but it is still quite possible for botanists to direct efforts into proper channels. Will they take enough interest in it to do it? The committee having the preliminary work in charge will shortly issue an address containing a series of questions to which they desire categorical answers. If American botanists have not enough enthusiasm respecting an international congress to express their opinions when asked, we can hardly anticipate that they would have enthusiasm enough to come to such a congress or aid in the entertainment of their guests.

BUT BOTANISTS have a further duty. If they do not approve of the attempt and will not lend both encouragement and assistance, the committee ought to know it in time, so that the American botanists may not be committed to an invitation which they do not extend heartily. Already an announcement has been made by the auxiliary that such a congress is to be held. It remains for the botanists either to direct, it or to let it be known that this invitation if further extended does not come from them, and that it is only a part of the general commercial enterprise. The committee of botanists who have been asked to assist in the arrangements see very many difficulties to be removed before a personal and cordial invitation can be issued. If

proper backing can be secured, moral and financial, they think that a botanical congress can be made highly successful in all respects. The greatest difficulty which they have met so far has been —*your* indifference.

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ANOTHER MATTER of great interest to botanical science is the proposed division of section F of the A. A. A. S. This proposal the GAZETTE opposed when it was made several years ago. We have seen reason to change our minds. Editorially and through the letter of Dr. Halsted, we have endeavored to find out how others regarded the proposition, but we have been unable to extract a single opinion, pro or con. So far as expression of their sentiments is concerned, the botanists might as well be dead!

CURRENT LITERATURE.

A manual of grasses.[1]

The study of the grasses of the United States has long been one of the special functions of the Botanical Division of the Department of Agriculture, and a vast amount of material has been accumulated in the National Herbarium. For many years Dr. George Vasey has been making this great collection of grasses his special care, and his various papers from time to time have testified to his critical study. It has been felt for a number of years that he should put the results of his labors in monograph form, so that botanists in general might share his wide knowledge. In answer to this demand, Volume III of "Contributions from the National Herbarium" opens with the first part of a "Monograph of the Grasses of the United States and British America." The second part, completing the monograph, is promised in a few months. The monograph is in regular manual style, with suitable keys, and a full index which includes synonymy. The author has done a good service to American botany in bringing together our scattered accounts of North American grasses, and the monograph will undoubtedly stimulate the wider study of this very important and very critical group. The Department, as well as the Botanist, is to be congratulated upon the evident desire to cultivate botany for its own sake, and to use some of its money and material in rendering service to the botanical world, as well as to purely agricultural interests.

[1] VASEY, DR. GEO.—Monograph of the Grasses of the United States and British America. Contributions from the U. S. National Herbarium, Vol. III, No. 1, pp. xiv, 89. Issued, Feb. 25, 1892. Government Printing Office, Washington.

Thin wood sections.

The usefulness of well prepared transparent sections of various kinds of woods for numerous instructive and illustrative purposes, is conceded by every one, and by no one more than by the person who has had the privilege of using them. About ten years ago Mr. Henry Brooks, of Boston issued a set of seventeen species of woods, each species represented by three sections, a radial, a tangential and a transverse one, neatly mounted upon cards behind mica slips. Somewhat later a larger set, representing about 200 species of woods, mounted much in the same manner, was prepared by Charles W. Spurr, of Boston, under the direction of Dr. C. S. Sargent, using material from the "Jesup collection" of the Central Park museum, New York. Only a limited number of this set was issued.

There is now in course of publication a third set of wood sections.[1] These are prepared and mounted in a similar manner to those of the preceding sets, except that mica facing is not used, and that a number of minor details are added to increase their usefulness. A new feature of much importance is a well arranged accompanying text.

The author is Mr. Romeyn B. Hough, son of the late Franklin B. Hough, who was for some time U. S. Commissioner of Forestry, and throughout a long life was a student of our native ligneous flora, being the author of a treatise on the "Elements of Forestry," and of numerous other works of a kindred nature. The son has inherited his father's love of the forests, and he has entered into the preparation of the present work with the rich accumulations of information at hand brought together by his father, and with a strong personal enthusiasm.

The work is to be issued in parts of twenty-five species each, each part with a suitable text. The parts will appear as rapidly as they can be prepared, and the whole work is expected to eventually embrace all the most important woods of the United States. Two parts are already issued. The price is five to ten dollars per part according to the style of binding.

The work has a scientific and economic interest, both of which features are admirably met by the accurate naming and preparation of the material and by the extended and important information given in the text. The form in which the work is put up is very ingenious and handy, each part making a volume resembling an ordinary book, although the sections are upon free cards.

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[1] Hough, Romeyn B.—The American woods, exhibited by actual specimens and with copious explanatory text. Lowville, N. Y., pub. by the author. 8vo. Pt. I, 1888. pp. vii+79. figs. 42. 27 cards bearing three wood sections each. Pt. II, 1891.

A large series of lantern slides of wood sections is also prepared by the author, and sold separately. They make particularly beautiful and instructive objects for class use. Untreated wood-section cards of all sizes up to 4½ by 6 inches are also made. They have a fine ivory-like appearance, and may be used for a great variety of useful and decorative purposes.

The Oak.[1]

Looked at as an independent treatise, we have in this book a succinct account of the development, anatomy and economic relations of the English oak, forming a compact little volume that will be useful to every student of forest biology. Space limitations have sometimes necessitated a lack of fulness in statement that tends to obscurity, but in the main the work is good, clearly put, and accurate.

The Modern Science Series, of which this is the third volume, aims, so its editor, Sir John Lubbock, says, "to give on each subject the information which an intelligent layman might wish to possess." We can hardly imagine, however, that any layman, even an intelligent one, would be able to read this book understandingly unless he had had thorough instruction in vegetable anatomy. For example: the account of the course of the fibro-vascular bundles of the stem and their relation to the leaf traces (pp. 43–51) is hard reading even for one who has considerable previous knowledge of this subject both by reading and dissection. This fault, which can be considered a fault only in the light of the editor's preface, runs all through the book.

In these days when University Extension is coming to be such a popular thing we can foresee for this book a useful service. A course of lectures on the life history of plants could be built around it, and the book then be recommended for the supplementary reading which most of such courses require. The simplification and expansion by the lecturer would counterbalance the technicality and conciseness of Mr. Ward, qualities which under such circumstances become desirable. The number of books which can be used in this way is yet very limited and we are glad to recommend this one for this purpose to any who are wondering what they can find for such use.

The illustrations are in the main very good. Some are spoiled by too much reduction (e. g. those on pp. 57, 58, 59, and 111) and some are rather to large for the page, especially those in the chapter on the cultivation of the oak. The make up of the book is very attractive.

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[1] Ward, H. Marshall:—The Oak, a popular introduction to forest-botany. Modern Science Series (edited by Sir John Lubbock) vol. III. 12mo. pp. vii+175. New York: D. Appleton & Co. 1892. $1.00.

Minor Notices.

MR. H. J. WEBBER has published an Appendix to the Catalogue of the Flora of Nebraska. The flora of this very interesting state is being vigorously investigated, and as the somewhat arbitrary line between the eastern and western manuals runs through it, such a list as this appendix contains unusually affects their contents. The appendix adds 432 species to the original catalogue, and the recorded Nebraska flora now contains 48 protophytes, 115 zygophytes, 27 oöphytes, 808 carpophytes, 60 bryophytes, 19 pteridophytes, and 1245 phanerogams; in all 2322 species.

THE 23d Contribution from the Herbarium of Columbia College is entitled "The American Species of the Genus Anemone and the Genera which have been referred to it," by N. L. Britton. In this paper Dr. Britton reviews the various notions as to generic limitations, and casts in the weight of his authority against consolidation, regarding Anemone and Pulsatilla as worthy of being considered distinct genera. Hepatica and Anemonella are also kept distinct, the latter bearing the older generic name *Syndesmon* Hoffmg. In addition to these genera which are represented from North America, the other American genera, Capethia and Barneoudia, are considered. Pulsatilla, thus revivified, contains two species, the old Anemone patens, var. Nuttalliana, appearing as P. hirsutissima (Pursh). Anemone, thus delimited, is credited with 28 species, 9 of which are confined to South America. Two new species of the United States are *A. Tetonensis* Porter, of Idaho, and *A. Lyallii* Britton, of the northwestern Pacific region.

NOTES AND NEWS.

A PRELIMINARY LIST of the mosses of Lancaster County, Penn., has been published by John K. Small of Lancaster, and enumerates 150 species.

MR. F. W. DEWART has been appointed general assistant in botany at the Missouri Botanical Garden *vice* Mr. Hitchcock, who has gone to Manhattan, Kans. His duties began March 1.

THE FEBRUARY NUMBER OF AGRICULTURAL SCIENCE contains two botanical articles: "Notes on the flora of Thunderhead Mountain, Tennessee," by T. H. Kearney, Jr., and "Some recent contributions to mycology," by F. L. Scribner.

PRESIDENT JOHN M. COULTER is lecturing to large University Extension classes in Evansville and New Albany, Indiana, and Louisville, Ky. Each course includes twelve lectures upon the general morphology and physiology of plants.

In addition to continuations of articles already noted, the March number of the *Forstlich-naturwissenschaftliche Zeitschrift* contains the beginning of a paper on the "Influence of living and dead soil covering on the temperature of the soil," by Professor Dr. Ebermayer of Munich.

It is always interesting to follow the track of rare plants, and some articles concerning the proper home of Calypso, were lately published in the Gazette. It seems, however, that it is also quite at home in Europe, as Mr. H. Samzelius happened to find not less than 400 flowering specimens in a birch-forest near Tornio river in the Tornio-Lapmark last June.[1]—T. H.

A committee of prominent botanists has undertaken to remove Stephan Endlicher's body from its unmarked grave in the Matzleinsdorfer Cemetery near Vienna, to the new Central Cemetery, and to provide a suitable monument to the memory of this distinguished botanist and philologist. Contributions may be sent to the k. k. zoologisch-botanische Gesellschaft, Wien 1, Herrengasse 13.

Mr. F. W. Anderson's valuable mycological collections have been donated to Columbia College, New York. He was associated at his death with Dr. and Mrs. N. L. Britton, and his collection being in their care was donated to that institution. His large herbarium of phanerogams is now in the possession of Rev. F. D. Kelsey undergoing revision, and when this is finished it is donated by Rev. Joseph Anderson to Deer Lodge College, Montana, as a memorial of his son.

Alida Olbers has investigated the structure of the pericarp of the Labiatae.[2] The investigation shows that the structure of the pericarp in the Labiatæ is very uniform, although the author has succeeded in finding several differences. These structural differences do not correspond, however, to the systematic position of the genera in which they have been observed; the same group may show different types, while the same type may occur in several and mutually different groups.—T. H.

Dr. M. C. Cooke, the editor of *Grevillea*, announces that with the issue of the next number (June) the twentieth volume and the series will come to an end. His fickle health and increasing years render necessary his withdrawal from the editorship. Whether the journal will be continued in other hands or whether it will come to an end remains an open question. We hope that if it is continued it will cease to be a "species mill" and become an English journal with somewhat the scope and standing of Hedwigia and other cryptogamic periodicals.

The southern tomato blight is treated by Dr. Byron D. Halsted in bulletin No. 19 of the Mississippi Agric. Exper. Station. This is the first time the disease has been critically studied, although it appears to have been known for some time, and to be of considerable commercial importance. Prof. Halsted decides that it is of bacterial

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[1] Botaniska Notiser, 1891, p. 174.

[2] Bihang till Kgl. Sv. Vetensk. Akad. Hdlgr., Vol. xvi, part iii, Stockholm, 1891, 20 pp., 2 plates.

nature, and identical with a blight of potatoes. He also inclines to think that it is caused by the same microbe that produces the disease in melons, an account of which was given in the preceding volume of this journal, p. 303.

CROSSING VARIETIES OF CORN has been conducted at the experiment station of Kansas since 1888. The results obtained in 1891 are given in bulletin No. 27, by Prof. W. A. Kellerman. The general conclusions which Prof. Kellerman draws from the whole series of experiments are "that the characters of so-called distinct varieties of corn can, by means of cross-fertilization, be made to blend more or less completely," and that the "blended form, or 'cross,' so far as our experiments indicate, does not generally (if kept free from contamination by foreign pollen), revert perceptibly to the parental types."

MACARONI AS A SOLID MEDIUM upon which to cultivate bacteria is advocated by Prof. G. de Lagerheim, (Centr. f. Bak. u. Par., XI, 147). The sticks are cut into pieces about 4½ cm. long, placed in test tubes, enough water added to cover them, and then boiled about fifteen minutes, or until well swollen and white. The water is now poured off, the tubes closed with cotton plugs, and steam-sterilized in the usual way, when they are ready to use. It is intended to take the place of potato in a measure, as more convenient and satisfactory, and also to add another culture medium for diagnostic purposes, as some bacteria have already been found that will grow upon potato but not upon macaroni.

AT THE REQUEST of Baron Ferd. von Mueller in Melbourne, Baron Otto Nordstedt has undertaken the work of writing a monograph of the Australasian Characeæ, the first part of which has lately been issued by R. Friedländer & Sohn, of Berlin. References are given to preceding papers, which deal with the same subject. Allen's "Characeæ of America" is especially commended for the study of the anatomy and morphology of these plants. Of the ten species, described in the first part, following are new: *Nitella partita*, *N. tumida* and *Chara Leptopitys* A. Br. subsp., *subebracteata*. The paper is accompanied by ten plates illustrating the plants in natural size, accompanied by numerous enlarged details.—T. H.

THE PRESENT SYSTEMATIC arrangement of the phæosporic algæ is not satisfactory. A valuable contribution in regard to the correct understanding of several species heretofore referred to *Adenocystis* has been given by Prof. Kjellmann.[1] He revises the following species: *A.* (*Lessoni* var.?) *Californica* Rupr., *A. Lessoni* Harv., *A. Durvillaei*? Herb. Holm. in sched. and *A. Durvillaei* (Bory) et auct. The result of his examination is that these really represent four different genera, belonging to four families namely: *Adenocystis* Hook. fil. et Harv. of the family LAMINARIACEÆ; *Coilodesme* Strömf., by Strömfelt referred to CHORDARIACEÆ; *Corycus* n. gen. of PUNCTARIACEÆ; and finally a yet undescribed genus of the family SCYTOSIPHONACEÆ.—T. H.

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[1] KJELLMANN, F. R.: Undersökning af naagra till slægtet Adenocystis Hook. fil. et Harv. hænförda alger. (A study of some Algæ, which have been referred to Adenocystis by Hooker fil. and Harvey.) Bihang till Kgl. Sv. Vetensk. Akad. Hdlgr., vol. XV, Part III, Stockholm, 1890.

Two new species of red mycoderma are described and figured by A. Lasché in *Der Braumeister* for March (v. 278). These belong to the class of plants usually called yeasts, but in reviewing the literature he points out that no true colored yeasts, i. e. spore-producing Saccharomyces, have yet been described. The more interesting of the new species is *Mycoderma Humuli*, found upon the leaves of the hop, Humulus Lupulus. It has the marked characteristic of producing new cells by first forming a promycelium, instead of budding directly. The other species was found by accident in making plate cultures, and so came from the air. It is named *M. rubrum*, and shows some tendency toward the occasional formation of promycelium.

At the last meeting of the Chamisso Botanical Club, of Berkeley, Cal., one of the members enumerated ninety-eight species of phanerogamic plants in flower in January. The number, though considered quite large, was not the result of systematic investigation but only those casually noticed in flower about Berkeley and on two excursions to the opposite side of the bay. The limits of the list are within ten miles of San Francisco. It is noteworthy that a large proportion are introduced plants which here find congenial conditions, or species of extensive or nearly world-wide range. Professor Greene called attention to the manner of leaf propagation discovered in *Cardamine Californica*, a method known only in two other Californian plants and in few others elsewhere. Other members read papers of local botanical interest.—W. L. Jepson.

Until quite recently it has been assumed that the growth of the mistletoe was necessarily prejudicial to the tree upon which it grows. With the discovery of "symbiosis," or that arrangement whereby two plants live in intimate association one with the other without injury to either, but perhaps with reciprocal advantage, a different view has been taken, and an apple tree is supposed to be advantageous to the mistletoe growing on it in summer, while in winter the evergreen Viscum supplies the deficiency which the apple experiences by the loss of its leaves. M. Gaston Bonnier has been putting the matter to the proof by estimating comparatively the changes which occur in the composition of the two plants and of the atmosphere during growth. For half the year it is found that the mistletoe assimilates food by its green leaves for the denuded apple tree. We cannot give the details of M. Bonnier's experiments, but it is sufficient to say that they completely bear out the idea of perfect "symbiosis," or mutual adaptation, and that save by mechanical obstruction, the mistletoe does no harm to the tree on which it is growing.—*Gard. Chron.* Jan. 23. How is this conclusion borne out by our common American mistletoe?

Professor G. de Lagerheim, director of the botanical garden at Quito (Ecuador), announces the discovery of European Uredineæ near Quito.[1] He has observed *Puccinia coronata* upon plants of an Avena, the seeds of which had been introduced from Europe; which is the more interesting since none of the species of Rhamnus, upon which the corresponding æcidium lives, have been found yet in Ecuador.

[1]Botaniska Notiser, Lund 1891, p. 63.

The only explanation of this peculiar fact seems to be that the germinating oats were infected with teleutospores of P. coronata, and that both the æcidium and the uredo-generation were passed. According to Plowright,[2] who succeeded in infecting young plants of wheat with sporidia of *Puccinia graminis*, the æcidium generation may be passed, and Prof. Lagerheim supposes the same to be the fact with P. coronata in Quito. He has also found P. graminis near Quito, where it occurred on some varieties of Avena, although none of the species of Berberis, nor even Mahonia Aquifolium, which usually are bearers of its æcidium generation, exist in Ecuador. He is therefore inclined to explain the occurrence of Puccinia graminis in the same way as that of P. coronata.—T. H.

MM. Dewevre and Bordage propose in the February number of the *Revue général de Botanique* a method of analyzing and recording the movements of plants photographically. Instead of the interrupted observations as in the method used by Darwin and later investigators, they succeed in getting a continuous record. The difference is the difference between the occasional observations with an auxanometer and the record obtained by the registering instruments. The plants to be observed are placed in a dark box whose sides are pierced by apertures for the fronts of two cameras, one vertical and the other horizontal. To the tip of the organ to be studied is affixed a spherule of wax which furnishes the bright point whose movement makes the tracing on the sensitive plates. In case it is desired to avoid the alterations produced by darkness the plant and cameras are similarly arranged, uncovered. The dark background for the bright point is secured by placing opposite the cameras long tubes of proper diameter whose inner surfaces are blackened. In both cases the pot needs to be supported so that it can be lowered as growth occurs. The method is certainly a very ingenious one, and capable of valuable service. For the details and necessary cautions we must refer to the paper itself.

In order that the exhibition of weeds at the World's Columbian Exposition may be large, and representative of all sections of the country, Dr. Byron D. Halsted, of the N. J. Experiment Station, New Brunswick, N. J., (having this feature in charge) asks for specimens of the worst weeds from all states and territories. It is suggested that each botanist or local collector, who may be pleased to assist in the work, secure at least three specimens each of the worst weeds in his state or section. In making the specimens it is important that collectors obtain seeds, seedlings in various stages of development, the root system, the flower and flower cluster, and the seed vessels. It may be necessary, therefore, to secure these various essentials at different times during the coming season. If the weed is a large one stress is laid upon the procuring of specimens while they are small enough so that the whole plant, roots and all, can be mounted, without bending, upon a herbarium sheet of ordinary size, that is, not over a foot in length. Persons who will aid Dr. Halsted should signify their intention, and allotments will then be made according to the locality. It is hoped that each state in the Union may be represented by specimens in this national exhibit of our worst weeds. The collecting must all be done during the present season, and the specimens sent in for mounting, labeling, etc., by December 1st.

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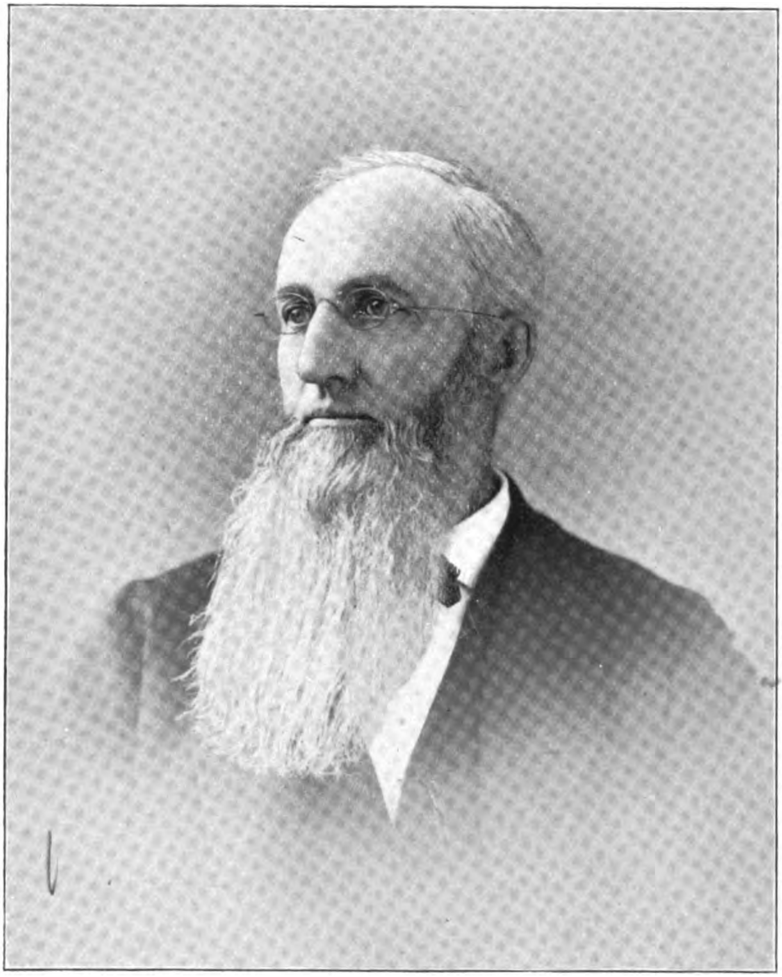
[2]The connection of wheat mildew with the barberry æcidium; Records of the Woolhope Transactions, 1887.



Yours very truly
Sereno Watson

BOTANICAL GAZETTE

MAY, 1892.

Sereno Watson.

JOHN M. COULTER.

(WITH PLATES VI AND VII.[1])

Sereno Watson was born December 1, 1826, at East Windsor Hill, Connecticut. He graduated from Yale College in 1847; taught school for several years in different states; studied medicine at the University of New York; was a practicing physician for two years at Quincy, Illinois; was secretary of the Planters' Insurance Company of Greensboro, Alabama, from 1856 to 1861; became a professional botanist in 1868; was botanist of Clarence King's U. S. Geological Survey during the seasons of 1868 and 1869; became Professor Gray's assistant at Cambridge in 1871; and was made Curator of the Gray Herbarium and Library in 1888, a position which he held at the time of his death, March 9, 1892.[2]

Such are the prominent dates and positions connected with the life of one who, at his death, was the most distinguished American student of systematic botany. His work will speak for itself, but the real flavor of his quiet life is known only to those of us who were fortunate enough to be intimately associated with him. To the chance visitor or casual acquaintance he seemed painfully reticent and unresponsive, but he hesitated at no trouble in serving those who sought his help; and many American botanists will always cherish the memory of his kindly, unrequited assistance. The priceless herbarium, under his care, still had the atmosphere of helpfulness so characteristic of its great founder. To turn from the memories of the friend to the cold recital of the work of the botanist is a necessary but uncongenial task.

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[1]The portrait (plate VI) is from a photograph by Pach, taken in January, 1887. It is selected by a friend as the best likeness of Dr. Watson. The herbarium interior (plate VII) is from a photograph taken about 1880.

[2]I am indebted to "Garden and Forest" (March 16) for the facts with reference to Dr. Watson's earlier life.

Sereno Watson appeared suddenly in the botanical world. So far as we know, he had no puerile work to lament, the common experience of most botanists, but when known as a botanist at all he was in the foremost rank. This stepping at once, full-equipped, among the leaders, without any preliminary service, is one of the distinguishing marks of his botanical career.

His apparently accidental connection as botanist with the U. S. Geological Survey under Clarence King was the occasion of his sudden celebrity as a botanist. Botanical collectors had visited the great west before and have multiplied since, but Watson brought back from the Great Basin region not only a magnificent collection of plants, but also such an ability to study it, that his report, technically known as the "Botany of the 40th parallel" (vol. V of the Clarence King's Reports), has become one of the classics of American botany. The appearance of this work in 1871 was the first announcement that America had another great botanist.

From that time he was the constant associate of Dr. Gray, devoting himself entirely to the study of the North American flora.

In 1876 there appeared the first volume of the Botany of California, a most elaborate presentation of the unique flora of the Pacific coast region. This volume was the joint work of Dr. Watson, Professor Brewer, and Dr. Gray; the first two elaborating the Polypetalae, the Gamopetalae falling to Dr. Gray. The second volume, appearing in 1880, was the sole work of Dr. Watson; and it was in this volume that his presentation of the mosses, although not a professed bryologist, showed the remarkable taxonomic power he possessed. This contact with the mosses led to his being asked, upon the death of Mr. Thomas P. James in 1882, to take editorial charge of Lesquereux and James' "Mosses of North America," then in press. This involved a vast amount of critical and editorial labor, and must have seemed a sad waste of time to a man overwhelmingly busy in other directions.

In 1878 there appeared the first part of his "Bibliographical Index", including the Polypetalae of North America. It is a great loss to American botany that Dr. Watson was not able to prepare the remaining parts, especially those including the Apetalae and Monocotyls. The only part that appeared, however, has been an immensely useful book; and

it must always stand as a monument to the patient, systematic, drudgery-enduring nature of the man. It is far more than a careful collaboration of references and synonymy; for it necessitated the revision of many groups and contains views unrepresented elsewhere. I imagine that no book has been more consulted by students of the North American flora than this one; in fact, in lack of a volume of the Synoptical Flora covering the same ground, this volume of the Bibliographical Index was all that made the study of North American Polypetalae possible in many herbaria. The number who have leaned upon Dr. Watson for synonymy and dates is far greater than their acknowledgement of such laborious but thankless service.

At the death of Dr. Gray, the writer had in hand a revision of Gray's Manual upon entirely new lines. The chief purpose was to enlarge its range and revise its nomenclature, but Dr. Gray had also planned a different style of presentation, and had furnished complete manuscripts of two or three small families as patterns. This work was brought to a sudden close by the death of Dr. Gray and the transfer of his copyrights to Harvard University. As is well known, however, the manual was revised, the work being assigned to Dr. Watson and the writer. It was really an imposition upon the former, for he could not take such responsibility lightly and did far more time-consuming work of revision than the necessities of the case demanded. The result was a manual more closely following the old lines than Dr. Gray had intended, but still fully as useful to the vast majority who use it.

The series of "Contributions to American Botany" which bears Dr. Watson's name represents some of our most important systematic literature. The series reached 18 in number, and extended from May 1873 to July 1891, chiefly in the Proceedings of the American Academy. In this series, his name is associated with the revision of the following orders: Chenopodiaceae and Liliaceae; and with the following genera: Lupinus, Potentilla, Œnothera, Ceanothus, Trifolium, Lathyrus, Megarhiza, Peucedanum, Lychnis, Eriogonum, Chorizanthe, and Rosa.

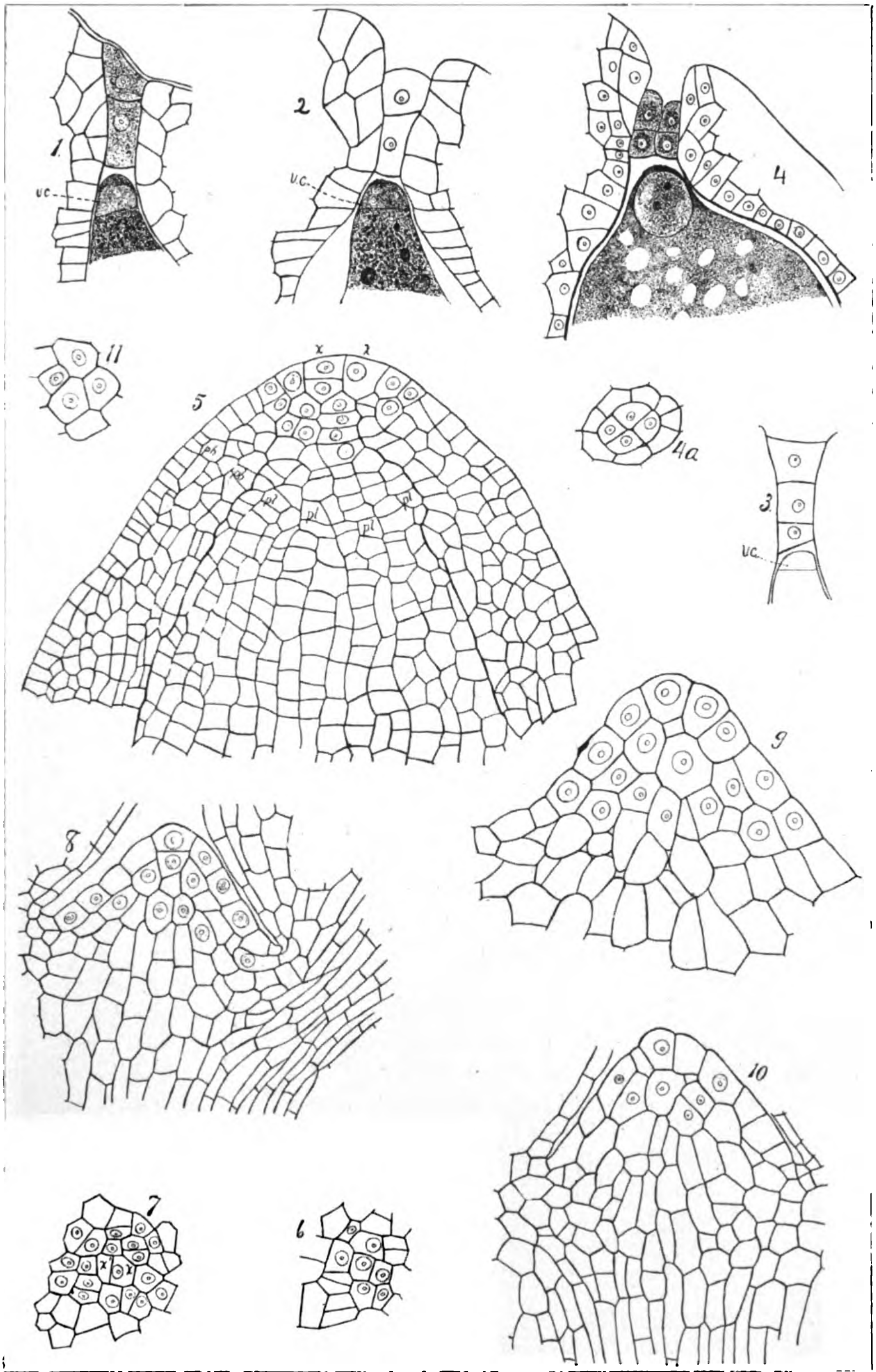
A large amount of his time was occupied in elaborating the rich Mexican collections of Pringle, and scores of new Mexican genera and species will always speak of his connection with that flora.

After Dr. Gray's death it was a fitting thing to so arrange Dr. Watson's time that he could have abundant opportunity to continue the "Synoptical Flora," and botanists were satisfied that this work would be continued more nearly in the spirit of its great author than in the hands of any other botanist. But now not a published page has been added, and our greatest botanical work bids fair to remain even more incomplete than its forerunner, the Flora of North America. However, much work had been done among the polypetalous orders, and it is to be hoped that that part at least can appear with something like completeness.

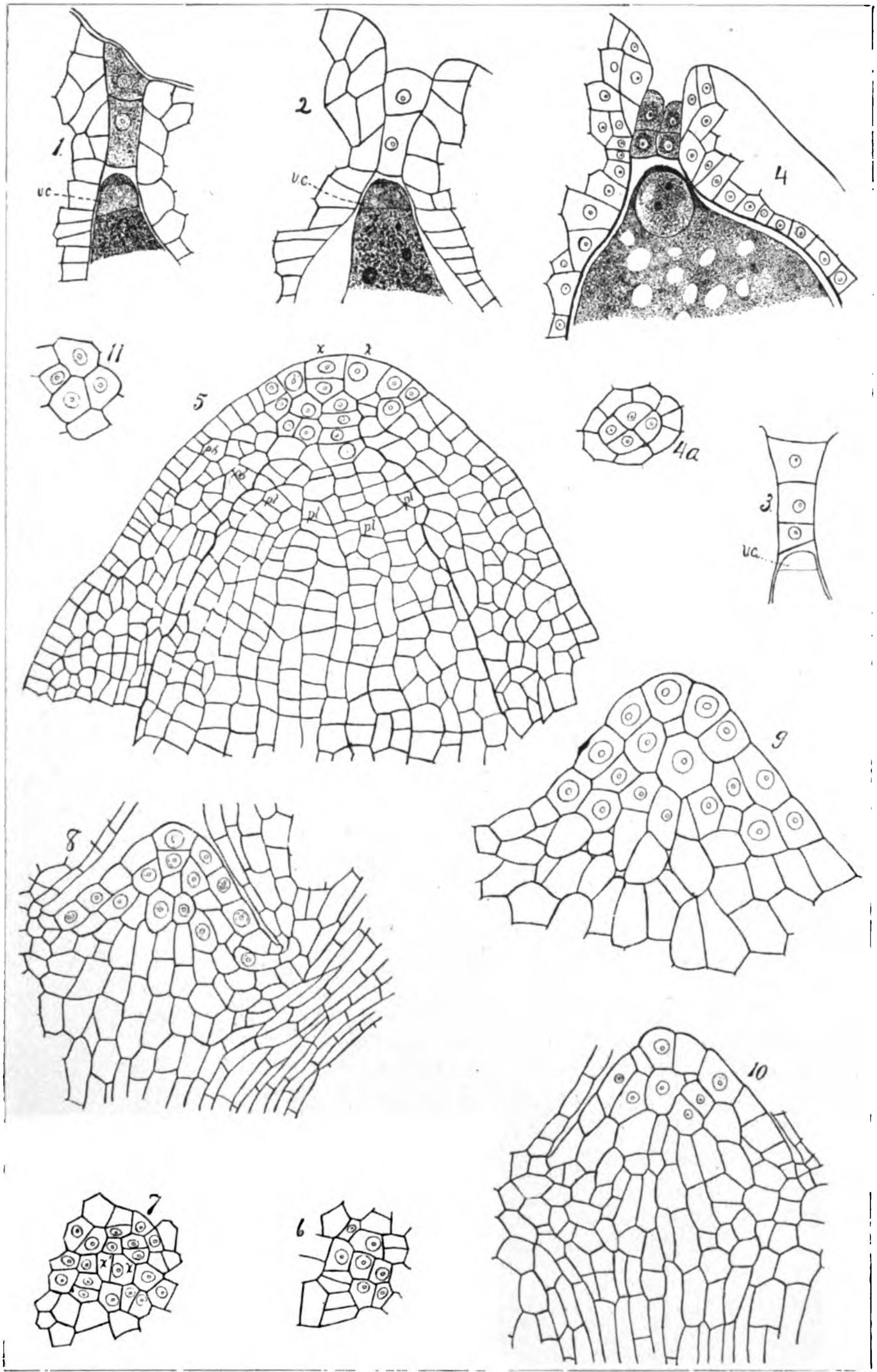
As a botanist, Dr. Watson was thorough and painstaking, the charge of hasty conclusions never having been laid at his door. His whole training and disposition compelled him to occupy a conservative position in the midst of the perturbations of sequence and nomenclature. He had to be very sure that right conclusions had been reached before his consent could be given; but his conservative views were never offensive and never appeared in public discussion. His disposition was simply to wait until things became more settled, and in the mean time to work quietly along in his own way. It has always seemed to the writer that Dr. Watson was remarkably gifted for doing safe systematic work. Lacking the grasp, the originality, the inspiration of our greatest botanist, he yet had that clear analytic vision and unflinching patience that lead to the best results. As I have heard him say: "I never can remember anything, but I can work it out"; and this seems to express his peculiar quality. It must be said in justice, however, that Dr. Watson's position in matters of ordinal arrangement was not so conservative as his writings would seem to indicate. His views on this point were clear and original. Recognizing the temporary nature of our present fabric of classification, he has frequently discussed with the writer the changes which were imminent, and only withheld a concrete public expression of his views because he did not deem his knowledge or any one's knowledge of affinities sufficient.

Systematic botany has lost another one of its great exponents, another one of that generation which is fast passing away. What the new generation is to do for the science is hard to predict, but it is evident that as the old leaders disappear we are to become more of a democracy. Sereno Watson's

INTERIOR of GRAY HERBARIUM.



MOTTIER on TSUGA and PINUS.



MOTTIER on TSUGA and PINUS.

place in the study of botany of this country can not be filled, for the conditions which made him have disappeared; but to many of us this loss will appear secondary, because we especially cherish the memory of the kind and helpful friend.

Indiana University, Bloomington.

On the archegonium and apical growth of the stem in Tsuga Canadensis and Pinus sylvestris.

D. M. MOTTIER.

(WITH PLATE VIII.)

To determine the true relationship existing between the different groups of the plant kingdom is yet a problem of great interest to botanists. The genealogical tree is still largely hypothetical and must necessarily remain so for some time to come. Now and then modern research fills up a gap or throws some light on the true line of development.

The gymnosperms, holding as they do a position between the pteridophytes and angiosperms, are perhaps as interesting as perplexing. It is, however, chiefly in the study of the reproduction, the development of the embryo and the meristems of stem and root that we are to look for the true affinities of the neighboring groups.

Several representative types of the gymnosperms have been carefully studied by Hofmeister and, later, by Strasburger and others. Since more accurate methods have come into use some of the work done by these botanists has been repeated, especially in cases concerning which there was doubt or difference of opinion.

Having had material in abundance, I recently made a careful study of the development of the archegonium in Tsuga Canadensis and Pinus sylvestris and found that in a few details my results do not quite agree with the account of Strasburger.[1] This investigator states that he can not affirm Hofmeister's statement that the neck of the archegonium of Tsuga Canadensis consists of two cells, one lying above the other, but that it remains one-celled, and only in rare cases did he find two. In a large number of specimens examined I found

[1] **Die Befruchtung bei den Coniferen, p. 6. Jena, 1869.**

the neck to be frequently of two cells (figs. 1 and 2). In one instance I found the lower cell divided by a cross wall, thus making three cells in all (fig. 3). This, however, is exceedingly rare for it was the only case observed out of the large number of ovules sectioned. In Pinus sylvestris the cells of the neck formed two layers instead of one (fig. 4) as stated by Strasburger.[1] Four cells lie in one plane (fig. 4a), making eight cells in the entire neck. At the stage of development represented in fig. 4 the ventral canal cell had not yet been cut off. A very large nucleus lay just beneath the neck while the remainder of the cavity of the archegonium was filled with granular protoplasm staining deeply with alum cochineal and containing many large vacuoles. In figs. 1 and 2 (Tsuga) the archegonium is mature, the ventral canal cell consisting almost entirely of a very large nucleus. The nucleus of the egg-cell occupied a central position. As regards other details in the development of the archegonium, I find them to agree with the account of Strasburger.

Apical growth of the stem.

In the BOTANICAL GAZETTE for January, 1892, Conway MacMillan, in a review of the work of Duliot on apical areas in seed plants, reports that author as concluding that in the gymnosperms the apical growth in the stem proceeds from a single apical cell. Unfortunately I have not had access to Duliot's paper, and do not know what species were studied; but from my investigation upon the stem of Pinus sylvestris the conclusion of Duliot seems to be very hasty at least. The growth in Pinus sylvestris corresponds very nearly with Strasburger's account for *Pinus Pumilio.*[2] A pretty well defined dermatogen layer passes over the entire apex which is relatively very large and cone-shaped at the period of active growth. The dermatogen is sharply defined from the periblem (fig. 5, *pb.*); so also the definition between periblem and plerome is very distinct (fig 5, *pl.*). At the extreme apex, however, the dermatogen cells are very much larger than the others, with very large nuclei. These *(x, x')* I take to be the initial cells. In this specific instance the dermatogen, periblem and plerome can all be traced to one or two large cells at the apex. This condition of things appears in three or four consecutive sections, though with not such great regu-

[1] l. c., p. 13.
[2] Die Coniferen und die Gnetaceen, pp. 327, 328. (1872.)

larity, showing that the apex is relatively broad. Transverse sections taken from the extreme tip show that it terminates in two or three large cells (figs. 6, 7), and it seems to me that we can not say with certainty that there is only one initial cell. Figs. 6 and 7 are consecutive transverse sections taken from the apex. In fig. 7 we have a near approach to what would lead one to regard the large cell, *x*, which has apparently just cut off a segment, *x''*, as the initial cell, both from its size and regularity in the arrangement of the cells about it. Yet this does not seem sufficient proof to warrant the conclusion. Fig. 5 is the only instance in which I found such great regularity; in all others the apex terminated in two or three large cells, which may be regarded as initial cells, but all approached nearly that shown in fig. 3.

In the apex of the stem of the embryo taken from the seed of Pinus sylvestris and Tsuga Canadensis, we find the nearest approach to a single apical cell (figs. 8, 9 and 10). It is quite probable that in the young state growth takes place from a single apical cell. In instances like that of fig. 8 this seems quite certain. In the embryo of Tsuga (fig. 10) this also seems to be the case, but in fig. 9 we can not be so positive as to the initial cell. A transverse section from the tip of the stem in a similar embryo shows two or three cells of uniform size (fig. 11).

In view of these facts it seems to me that we can not say that there is a single cell at the apex of the stem of the species under consideration, unless it be in the stem of the young plant, and even then not with absolute certainty.

All material used in this study was hardened in chromic acid (1 per cent.), thoroughly washed, stained *in toto* with alum cochineal or alum carmine, washed and dehydrated; then brought gradually into a saturated solution of xylol and paraffine, then into melted paraffine, imbedded and sectioned with a Minot microtome. The sections were counter-stained on the slide with Bismarck brown.

Indiana University, Bloomington.

Explanation of Plate VIII.—Figs. 1, 2 and 3, longitudinal sections showing neck of archegonium of *Tsuga Canadensis; vc*, ventral canal cell. Fig. 4, same of *Pinus sylvestris;* 4 *a*, transverse section through the neck of archegonium of P. sylvestris. Fig. 5, longitudinal section through the apex of the stem of P. sylvestris; *pb*, periblem; *pl*, plerome. Figs. 6 and 7, consecutive transverse sections of the apex of the stem of P. sylvestris. Figs. 8 and 9, longitudinal sections of the apex of the embryo stem taken from the seed of P. sylvestris. Fig. 10, same of Tsuga Canadensis. Fig. 11, transverse section of the extreme apex of the stem of the embryo of P. sylvestris.

All magnified 175 diameters, except fig. 8, 150 diameters.

Germination of the teleutospores of Ravenelia cassiæcola.

B. M. DUGGAR.

(WITH PLATES IX AND X.)

As far as can be ascertained the publications relative to the morphology of the genus *Ravenelia* have yet given no idea of the germination of the teleutosporic stage. From results of anatomical studies in 1886, Parker[1] concludes that the structure of teleutospores is really that of a cluster of fused teleutosporic stalks. Cunningham[2] gives an interesting exposition of the development of the successive forms in two East Indian species, and also traces the development of teleutospores. He shows that the cysts are essentially modified basal cells of the true spore cells, and their origin is illustrated. He makes clearer the relation borne to other members of the group of Uredineæ. However, his attempts at artificial cultivation of teleutospores proved failures,[3] and he is not positive as to the success of experiments relative to the artificial infection.

In the biological laboratory of the Alabama Polytechnic Institute, and under the direction of Prof. Geo. F. Atkinson, artificial cultures have been made with some successful results. Inasmuch as the designation teleutospore involves the idea of the production of promycelia and sporidia, we can expect results to be only of generic importance.

Since the genus is not as well known as its relatives, it may be well to observe some of the specific characters of *R. cassiæcola* Atkinson,[4] which I draw largely from the author's description. The teleutosporic form occurs most abundantly on the stems of the host plant, *Cassia nictitans*; yet it also attacks pods and leaves. The sori are usually irregularly oblong and very dark in color. The teleutospores are more or less brown, composed of from three to thirty somewhat wedge-shaped cells, the width of the head being usually from 50 to 90μ. The compound colored pedicel is from 10 to 18μ wide, and the length generally about 80μ, yet it may be twice

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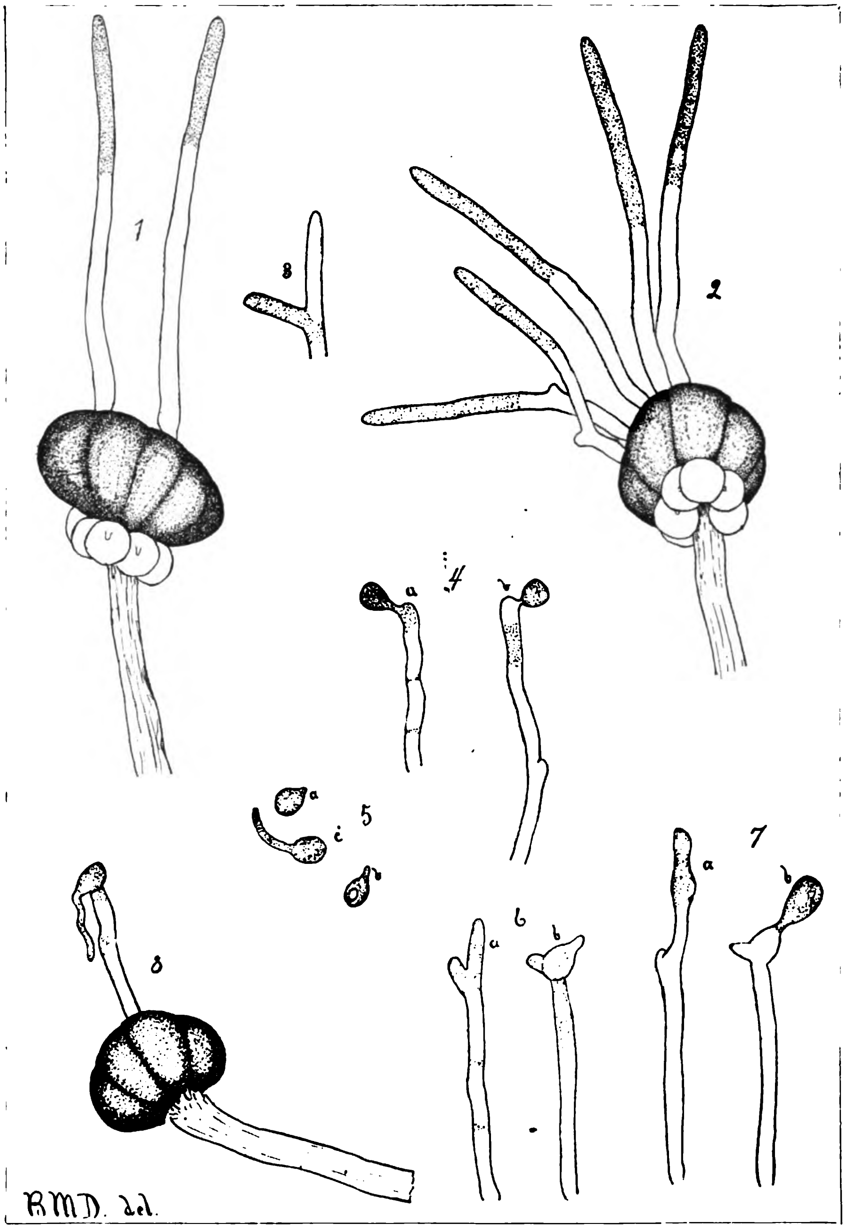
[1] Morphology of *Ravenelia glandulæformis*. Proc. Am. Acad. of Arts and Sci., vol. XXII.

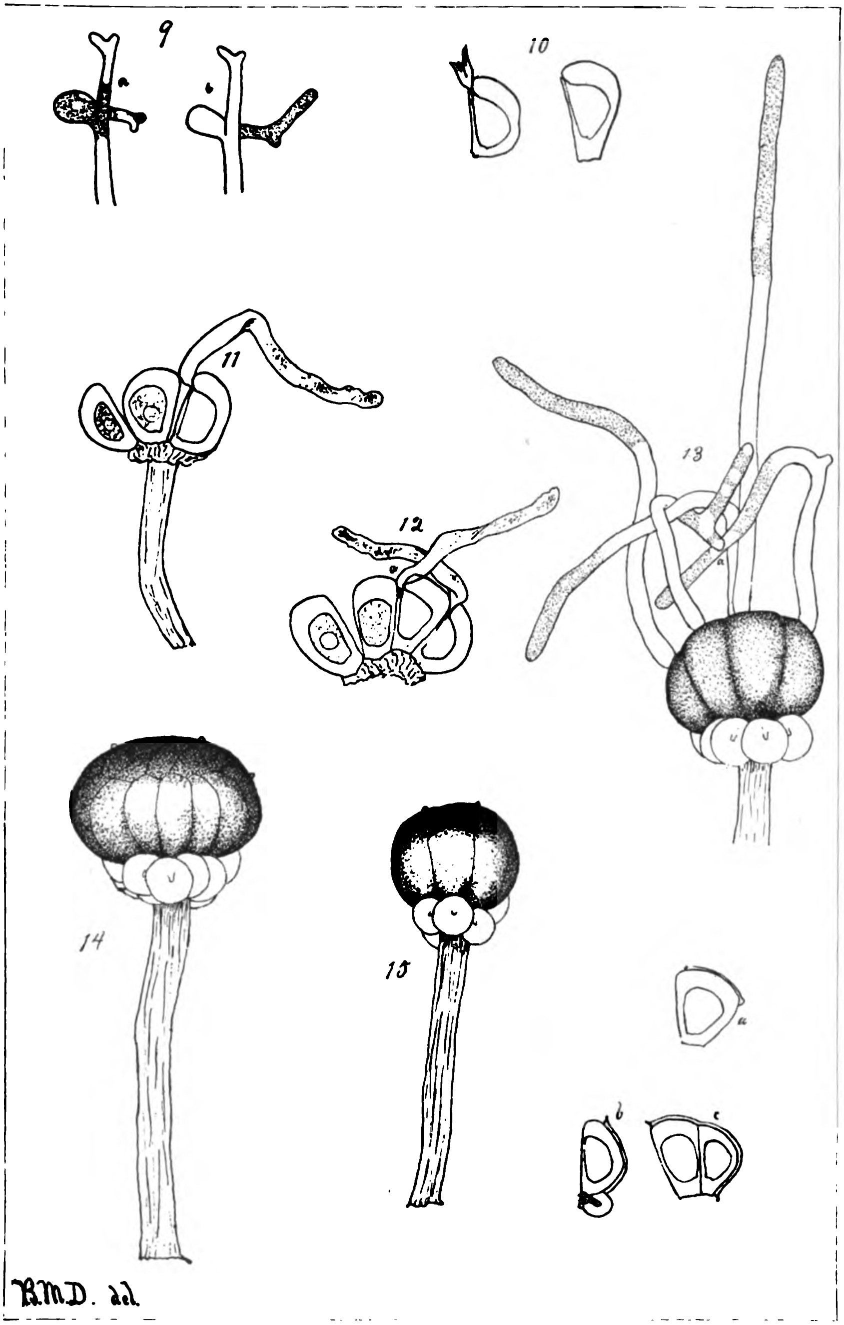
[2] Notes on the life history of *R. sessilis* B. and *R. stictica* B. & Br. Scientific Memoirs by Medical Officers of the Army of India.

[3] Cooke, Journ. Royal Mic. Soc., vol. III, p. 389, says: "The utmost that we have been able to accomplish has been to obtain single short germinating threads from the apices of a few of the pseudospores in *R. aculeifera*."

[4] Described in BOTANICAL GAZETTE, Nov., 1891, as "A new Ravenelia from Alabama."



DUGGAR on RAVENELIA.



DUGGAR on RAVENELIA.

as long. At the junction of the pedicel with the spore cells we observe the characteristic cyst cells. These are hyaline or slightly colored, usually spherical, and average about 12μ in diameter (for normal spores see figs. 14 and 15).

After remaining in water for some time, maceration of the spores is to a certain extent effected, and by slight pressure the individual cells are easily separable for examination. It is then apparent that *R. cassiæcola*, so far as the arrangement of cells is concerned, belongs to the division as noted by Parker of which *R. Indica* is the type; consequently the cells are only laterally coherent. Besides the close union of adjacent cells, there is an external coat common to all which holds them together more firmly. In thickness, this is less than the exterior walls of individual cells (fig. 16), and from its surface often appear short, hyaline or slightly colored spines.

Specimens of the host plant containing the fungus in good condition were collected early in December, after the death of the vegetation. Water cultures, both slide and cell, then manifested no germination after being observed for a number of days. To continue the preservation of the material as in a natural state, it was simply "heeled in" under a box in an exposed place, and it was from this material that results were finally obtained. Slide and cell cultures with both distilled water and sugar solution were failures early in January, but on Feb. 23 the first results were secured. This occurred only in the sugar solution, and nine days after the spores had been sown. The results here given are from the same. It may be of interest to note that well-dried herbarium specimens have germinated after remaining three weeks in a cell culture with water.

The promycelia issue about perpendicularly to the plane of cells, bending towards the upper surface in an abundance of the medium, and when the spore lies on its side. Until a little greater than the length of the head, they are observed to be simple tubes completely filled with protoplasmic contents. These tubes rapidly elongate, the protoplasm collecting in the distal extremity, and they become finally from two to five times the length of the head (figs. 1 and 2). A promycelium may become branched, usually when meeting an obstruction to its growth, and this may be nearly at right angles to the former course (fig. 3). In all cases, however, the protoplasm remains separated only a short time, rapidly

collecting in the growing extremity. Apparent septa are sometimes observed (fig. 4 *a* and fig. 6 *a*), but the deception results from a coherence of granular contents in a cross section of the tube; and by moving towards the point of growth, this protoplasm soon mingles with the mass at the normal location (fig. 7 *a*). Variations of the above may be found in the empty spaces sometimes noticeable (fig. 13, *a*, etc.), and these are most abundant after a considerable growth has taken place. Small vacuoles are not infrequent.

The sporidia are developed at or very near the terminal portion of the promycelia (fig. 4, *a* and *b*). The first evidence of this formation is shown by a part of the protoplasm collecting into a side branch, whose connecting portion is but little smaller than the main tube, and which assumes more or less the usual characters of a sterigma. With this development of sporidia a more highly refractive power is manifest. A sporidium measures about 9 μ in diameter, but its form is not generally spherical. In most cases the abscised reproductive body shows a prolongation at the end by which it was attached (fig. 5 *a* and *b*), the constriction which eventually sets the body free encroaching somewhat on the usual limits of the sterigma in the group of Uredineæ. Vacuoles are frequently present, but these vary in number and in size.

Sporidia are not always produced, and their absence is counterbalanced by a longer growth of the tubes. This greater growth probably results from the fact that the promycelia are completely immersed in water. Lagerheim[5], speaking of the germination in water of *Puccinia heterogena* Lagerheim, says, "They then germinate exactly like uredospores; a long non-septate germ tube, often bent backward and forward, and with a strongly undulating contour, grows out of the germ pore. . . . Probably the fungus can reproduce itself by these germ tubes, which, because they form no sporidia, penetrate directly into the leaf." It is possible that under favorable conditions the same may be true for the long promycelial growths of the fungus we are considering. A promycelium often shows an enlargement at the end, as if a terminal sporidium were to be produced, but instead, the tube may be again normally continued. With the above character, a geniculation is often noticeable, the new growth

[5] Journal of Mycology, vol. VII, no. 1.

resulting in the protrusion of the wall in an oblique direction; or the latter character may exist independently of the former. A peculiar instance is shown in fig. 9, *a* and *b*, where a sporidium seems to be almost fully developed laterally, then its wall is protruded from near its base into a new tube which again branches. It seems that a promycelium bears only one of these reproductive bodies, as more than that number have not been observed; still this cannot now be positively asserted. The true development of the promycelia is often interfered with on account of parasitic attacks. Owing to the large size of the spores of this fungus, they carry many adhering germs into the cultures, and the tender promycelial tubes are favorite spots for bacterial growth. It appears that the germination of a sporidium is by the prolongation of the pedicel-like end of attachment (fig. 5, *c*).

If the cells of a germinating teleutospore are separated by gentle pressure under a cover glass, the emergence of the promycelia from the germ pores can be noted. In the peripheral cells, which are externally somewhat convex, the germ pore is situated at the upper and inner extremity (fig. 10), while in the more angular central cells it may be at any distal corner (fig. 12, *a*). In all cases it is marked by the junction of the thick external cell wall with the thinner wall separating individual cells. The germ pore can be more distinctly seen by the usual examination with sulphuric acid.

In Ravenelia cassiæcola only has the germination of teleutospores thus far been observed, but these notes serve to indicate that the germination is generically characteristic. It differs from that of such typical genera as Puccinia, etc., in the non-séptate character of the promycelia, except in such species as P. heterogena above mentioned, where the germination takes place in an abundance of water. "In *Coleosporium*," says Plowright,[6] "each cell produces a single promycelial spore," and from his illustration of *C. senecionis* we observe that the tube which bears this sporidium tapers gradually to a very small size. Now if we deem both promycelium and sterigma essential terms, it is difficult to differentiate their limits in such cases. Sorauer[7] only states that each cell develops a simple promycelium with a sporidium. De Bary[8] defines

[6] British Uredineæ and Ustilagineæ, p. 45.
[7] Pflanzenkrankheiten, 2te Aufl., II, p. 244.
[8] Morphology and Biology of the Fungi, etc., p. 281.

the character of producing a single sporidium as peculiar to Coleosporium, but he names the entire tube from which this body is abscised a sterigma. Since the term sterigma is more or less broad, we may regard *Coleosporium* as possessing a truly non-septate promycelium, and still the above details will perhaps make clear the essential modifications in R. cassiæcola and probably the general features in the germination of the genus Ravenelia.

Polytechnic Institute, Auburn, Ala.

Explanation of Plates IX and X.

Plate IX.—Fig. 1, germinating teleutospore, showing normal condition of promycelium. Fig. 2, same as above with a slight geniculation and rudimentary branching. Fig. 3, a promycelial branch almost at right angles to the former course. Fig. 4, *a* and *b*, stages in the development of sporidia; *a* also shows apparent septa. Fig. 5, *a* and *b*, sporidia; *c*, sporidium germinating. Fig. 6, *a* and *b*, abnormal conditions of promycelia. Fig. 7, *a* and *b*, same as fig. 6, but representing appearances on following day. Fig. 8, teleutospore with single promycelium and abscised sporidium germinating while still in the vicinity of its point of production.

Plate X.—Fig. 9, *a* and *b*, peculiar development of a promycelium noted on successive days. Figs. 10, 11 and 12, representing cells separated by pressure, and showing the location of the germ pores and the emergence of the promycelia. Fig. 13, teleutospore germinating, but so surrounded by other spores that the promycelia are modified. Figs. 14 and 15, normal teleutospores of different number of cells. Figs. 16, *a*, *b* and *c*, individual cells, showing relative thickness of cell walls and the common external coat.

All figures were drawn under camera lucida.

Notes on Carex. XVI.

L. H. BAILEY.

An unusual amount of carex material has come into my hands within the last year, bringing a number of new species, extending the ranges of well known species to an important extent, and affording data for the clearing up of old doubts. These specimens have come from almost every part of North America and from very many collectors; in fact, the carex flora of the country has never had so many friends as at present. Some of the most important facts concerning the geographical distribution of species are recorded below.

Carex obesa All., var. *minor* Boott, heretofore not known south of Saskatchewan, was collected last July upon high bluffs at South Fowl Lake, Northern Minnesota, by F. F. Wood.

C. Torreyi, the rarest of the eastern carices, was found in abundance upon a small area in 1890, in the suburbs of Minneapolis, by J. H. Sandberg. This species was reported from New York and Pennsylvania a half century ago, but has never been rediscovered within Gray's Manual region until the present finding. It occurs in Colorado and in British America, and its reference to New York and Pennsylvania is probably an error. The original specimens were found in a European herbarium mixed with *C. pallescens* from New York and Carlton House, British America.

C. Tuckermani, reported no farther east than western New England, has been found at Kineo, Moosehead Lake, Maine, by Dr. G G. Kennedy.

C. chordorhiza, not known east of Vermont heretofore, is sent from Orono, Maine, by M. L. Fernald.

C. laxiflora var. *divaricata* has been collected at Natural Bridge, Virginia, by J. R. Churchill.

C. hystricina var. *Dudleyi* was found growing quite abundantly in a low place at Owosso, Michigan, by G. H. Hicks. This is the fourth station for the plant.

C. cephaloidea, not known east of western Massachusetts, where Dewey first found it, is now found in York Co., New Brunswick, by Mr. Brittain.

C. trichocarpa var. *Deweyi*, is sent from Ames, Iowa, by Professor A. S. Hitchcock. It has been known in the Manual region only from Dakota.

C. distans Linn., a European species, was found in ballast in Philadelphia, in 1877 and 1884, by I. C. Martindale. Mr. Martindale also found at Atco, N. J., in 1876, the true *C. flava* var. *Œderi* Lilj. This is the only finding of this plant in America, so far as I know. *C. panicea* is sent from Sellersville, Penn., by C. D. Fretz. This species, while very thoroughly established in some parts of Massachusetts, does not appear to extend itself rapidly into new regions.

Since the separation and proper delineation of *C. deflexa* and *C. Novæ-Angliæ*, these species have been sought and they are found to be more frequent than the Manual record indicates. *C. deflexa* is not confined to "high mountains," having even been found in a low sandy pasture on the banks of Great Works River, S. Maine, by John C. Parlin. It is also sent from the Keweenaw peninsula, Northern Michigan, by O. A. Farwell. *C. Novæ-Angliæ* is frequent at Mt. Desert, and

Edwin Faxon sends a fine suite of specimens from the White Mountains: from Profile Lake and Bald Mt., Franconia Notch; White Mt. Notch near Willey House; woodland cleared of trees, between Fabyan's and base of Mt. Washington; summit of Mt. Willard. It is strange that this well marked species should have been so long overlooked.

Three species are added to the Manual region from Nebraska: *C. Nebraskensis* Dewey, from Anselmo, Custer Co., and Hot Creek Basin, Sioux Co., by H. J. Webber. This is the first time the species has been found within the present limits of Nebraska. *C. Douglasii* Boott, Anselmo, Custer Co., Webber. *C. marcida* Boott, Anselmo and Broken Bow, Custer Co., and Thedford, Thomas Co., Webber; Alliance, Box Butte Co., G. D. Swezey.

C. canescens var. *dubia* Bailey, which has been one of the most obscure forms of a perplexing species and which has been known only from one collection in the Uintah Mountains and another in the Wahsatch, is now represented in my herbarium by good specimens from the Blue Mts. of Eastern Oregon (Cusick), Skamania Co., Washington (Suksdorf), and Tulare Co., Cal. (Coville, 1506 Death Valley Expedition). It proves to be well defined.

Among the novelties, the following appear to be supported by sufficient evidence:

C. herbariorum n. sp.—One of the FERRUGINEÆ allied to *C. ablata* and *C. luzulæfolia*: tall and slender (2 ft. or more?), smooth throughout; leaves broad ($\frac{1}{4}$ or $\frac{3}{8}$ in.), thick and stiff and apparently half evergreen, long; staminate spike single, an inch or two long, on a stalk of about its own length, rusty, the scales nearly linear and pointed; pistillate spikes 3 or 4, approximated near the top of the culm, erect, an inch or so long, evenly cylindrical, rather loosely flowered, rusty, on stalks once or twice their own length and springing from loose sheaths about an inch long which are tipped with an awn-like projection of similar length; perigynium medium or below in size, lanceolate, prominently excurved at maturity, strongly nerved and 2-toothed, smooth, about the length of the ovate and pointed brown-margined scale.—A well marked species with perigynia reminding one of the interesting VIGNEASTRÆ section. Habitat unknown. The species was found in a miscellaneous batch of nondescript carices from Herb. Olney (Brown University), without date, locality or

collector. Since the determination of the species, James L. Bennett, of Brown University, writes that the plant was collected by Wheeler's Expedition West of the 100th Meridian. In Wm. Boott's report upon the carices of this expedition there is nothing to suggest this species.

C. Pringlei n. sp.—One of the PALUDOSÆ, not closely allied to any American species, but coming nearest, perhaps, to *C. riparia:* tall, stiff and stout (four to six feet high), pale throughout, the culm obtusely angled and smooth; leaves stiff and long, rough on the edges and sometimes on the keel; staminate spikes three or four, an inch or two long or the terminal one twice longer, cylindrical, scarcely stalked, the bases enveloped by a scarious bract, the scales of the spikes linear and membranaceous with a somewhat expanded tip which is more or less jagged and provided with a short cusp; pistillate spikes three to six, all approximated or aggregated, heavy and densely flowered, two to four inches long, sessile and erect, their bases subtended by an expanded and long-pointed bract; perigynium long-linear-elliptic or linear-ovate (about four lines long), thin and flat, the small and stipitate three-angled achenium lying nearly in the center, faintly few nerved, beakless, the orifice entire or slightly sulcate, the lower portion smooth, but the upper part sparsely hairy, about the length of or slightly shorter than the strong-pointed or even awned rough scale.—A coarse bushy-spiked species with something the look of *C. spissa;* collected August 4, 1891, on borders of pools and streams in alkaline meadows one hundred miles east of the city of San Luis Potosi (Hacienda de Angustura), Mexico, by C. G. Pringle (No. 3801).

C. xerantica n. sp.—Group OVALES, between *C. pratensis* and *C. fœnea*: differs from the above species in its short erect silvery-white head, and broader, much firmer and nerveless perigynium. It is a tall and very stiff species with a straminea-like aspect, and dry appearance. It was collected at File Hills, British America (104° longitude, and 50½° latitude), by John Macoun, July 4, 1879, and at Moose Jaw, about thirty miles west and forty south of File Hills, by the same collector July 18, 1880, in both of which stations it was rather abundant. I have endeavored for a number of years to refer this perplexing plant to some of its neighboring species, but the attempt is always unsatisfactory. Its characters are constant in a good suite of specimens, and it appears to merit specific distinction.

C. Montanensis n. sp.—Belongs to the RIGIDÆ and is allied to *C. Tolmiei*, although it has much the habit of the PENDULINÆ (as *C. Magellanica*): a foot or a foot and a half high, in tough clumps, the culms weak at the top and mostly nodding, somewhat overtoping the flat and rather soft narrow (1½ to 3 lines wide) leaves; staminate spike single, about a half inch or less long, ovate or ovate elliptic, brown-purple, on a short and weak stalk, the scales thin and mostly blunt; pistillate spikes three to five, borne at the top of the culm and drooping or nodding on slender stalks, from one-half to three-fourths of an inch long, dark colored, the lowest bract leafy and about equalling the culm; perigynium ovate, soft, nerveless (entirely lacking in the granulated character of *C. Magellanica* and its allies), terminated by a short and very slightly toothed beak about the length of but broader than the black-purple blunt scale; stigmas two or three.—Montana, Upper Marais Pass, W. M. Canby, Aug. 2, 1883 (no. 350), and along subalpine streams, Park County, Frank Tweedy, Aug. 5, 1887. Also on mountain slopes, Kootanie Pass, Rocky Mountains of British America, John Macoun, Aug. 9, 1883. I have at different times referred this plant to *C. atrata* var. *ovata* and *C. Tolmiei*.

C. bella n. sp. (*C. atrata* var. *discolor* Bailey).—This beautiful plant appears to have no immediate connection with *C. atrata*, and when I first referred it to a variety of that species I thought that "it is not improbable that it is specifically distinct from *C. atrata*" (Journ. Bot., Nov. 1888). It is more closely allied to *C. Mertensii*. It is a slender plant, about two feet high, the culms surpassing the flat and long pointed leaves; spikes 3 or 4, the terminal one prominently staminate below and the others usually bearing more or less staminate flowers at the base, all approximated, the lowest one or two drooping on very slender peduncles and the upper ones sessile or nearly so, all narrowly cylindrical (about 1 in. long), compactly flowered, the whitish perigynia contrasting forcibly with the purple scales; perigynium ovate, whitish, thin and somewhat inflated, nerveless, abruptly contracted into a very small straight beak which is very lightly toothed or simply erose, much broader and mostly a little longer than the purple sharp pointed scale.—Mountains, Colorado, Utah, and Arizona.

C. varia Muhl. var. **australis** n. var.—Stoloniferous; spikes all distinct or at least not aggregated, the lowest one often entirely separated from the rest, all usually longer than in the species itself; staminate spike straight and conspicuous. Tupelo and Starkville, Mississippi, Tracy; Houston, Texas, Nealley; and Hockley, Harris Co., Texas, Thurow.

C. aquatilis × stricta. A pronounced hybrid between these species has been found in some quantity at Orono, Maine, by M. L. Fernald. The hybrid is fully as vigorous as *C. aquatilis*, and is glaucous, but the perigynia and scales are stricta-like, although the spikes are large and thick, as in *C. aquatilis*.

Material wanted.—A carex which is said to produce good pasturage is reported to grow in Louisiana, but I have not been able to secure good specimens of it. I have obtained a bunch of the dry leaves and some loose perigynia from a correspondent in Grant Parish, central Louisiana, and I am not able to place the specimens with any species. It appears to be undescribed. My correspondent writes me as follows: "The plant grows here in the forest upon alluvial lands upon certain portions of the Red River bottoms. Near me are 500 or 600 acres covered with it upon which numbers of cattle and horses winter. It grows as thick as any grass, and not in bunches here and there, making a perfectly green and firm covering four to eight inches high." Unfortunately, my correspondent is not a botanist, and an expert witness is wanted to determine if all this pasturage is really a carex; and I desire good specimens of the plant for determination.

Our common *Carex echinata*, with its varieties, is in need of revision, and I shall be glad of any specimens which will throw light upon its variations.

Cornell University, Ithaca, N. Y.

An automatic device for rolling culture tubes of nutrient agar agar.

GEO. F. ATKINSON.

(WITH PLATE XI.)

Rolled culture tubes of nutrient agar agar are so convenient for the separation of many micro-organisms, and are employed by so many investigators for the study of the growth and conformation of colonies that any device for rolling them successfully is worthy of note. Especially is this the case when such device is, under certain circumstances at least, an improvement over the present methods in use.

The device introduced by Esmarch of spinning the tubes on the surface of ice water while a rubber cap covered the cotton plug was improved upon by Dr. Booker, of Johns Hopkins University by spinning them in a groove upon a block of ice.[1] This is an exceedingly satisfactory method. There is one difficulty encountered, however, which in many cases varies from a trifling to a very serious matter, according as ice is obtained with comparative ease or great difficulty. Those who are fortunate enough to be located in centers where trade demands for ice provide a constant supply, encounter simply a trifling expense and the little attention necessary to obtain the supply needed. Many institutions and workers, however, are so situated that it is almost impossible during the winter months to obtain ice without going to great expense, and many times during any season of the year the trouble alone of providing it is no small annoyance.

Being so situated myself I have given my attention to devising some means of rolling the tubes with precision by making use of the water supply commonly provided for in laboratory fittings. It is possible with a stream of cold water from a faucet to so hold with the hands and revolve a tube as to distribute and fix the nutrient agar in a thin and tolerably even film. But many failures result and at best the tube is far inferior to one rolled on ice.

Recently I have made an automatic device for rolling the tubes under a continuous shower of cold water as perfectly and regularly as it is possible to do on ice and with far less trouble even though a constant supply of ice is within easy reach.

[1]Mead Bolton: Schizomycetes, etc. Reference Handbook of Medical Sciences, vol. VI.

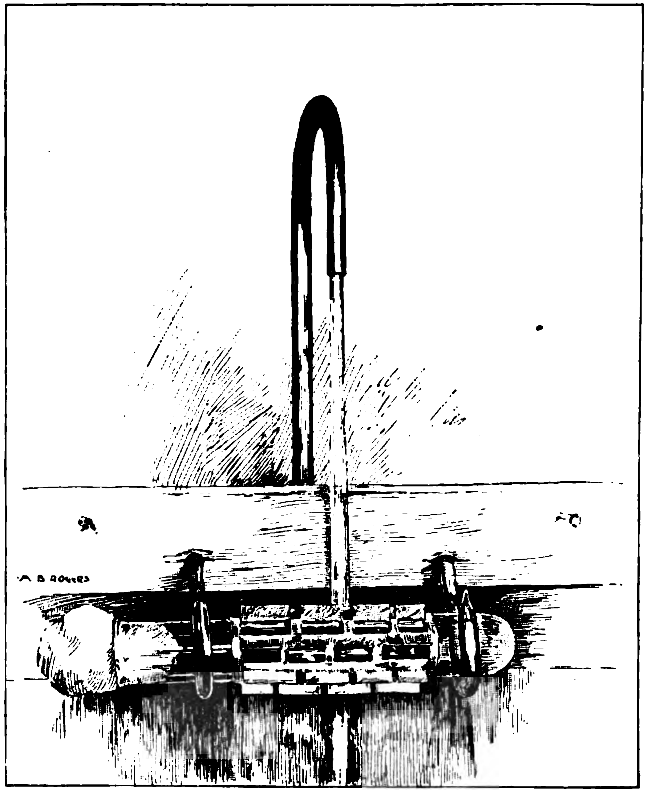


FIGURE 2.—Culture tube at rest.

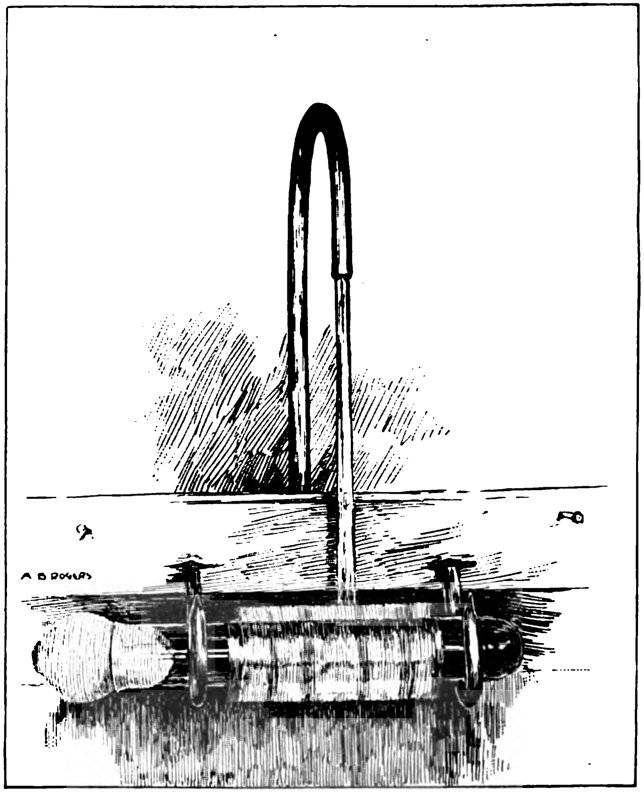


FIGURE 3.—Culture tube in motion.

ATKINSON on a DEVICE FOR ROLLING CULTURE TUBES.

It consists of a tin jacket, with rectangular perforations and bristling with "paddles," which grasps the tube and upon which the stream of water is so directed that it furnishes not only the motive power for whirling the tube but also the cold bath to solidify the agar agar. This device, quiet and in motion, is shown in figures 2 and 3 in plate XI.

The jacket I made in about an hour's time. It is quickly and easily slipped from one tube to another. The frame work which rests across the edges of the sink and holds the supports for the tube was the work of a few moments. The

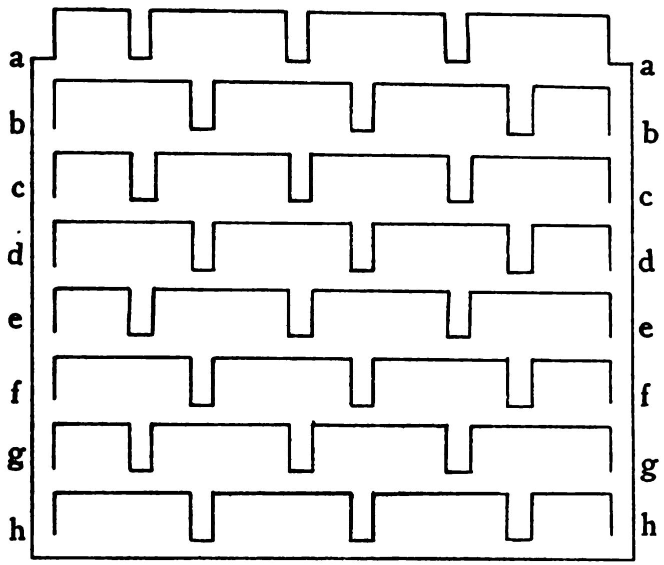


FIGURE 1.—Outline of jacket for rolling culture tubes. Full size.

jacket was made from a single piece of tin as follows: The tin was first cut the exact size of figure 1, three edges being straight while one edge was cut as shown in the figure. Now placing the sheet of tin upon a block of wood, with a quite narrow sharp chisel cuts were made corresponding to the irregular lines *b b*, *c c*, etc. The sheet was then placed in a vise down to *a a*, and the four rectangular projections bent perpendicularly to the sheet in the same direction that the chisel was driven. The sheet is then raised to the line *b b*, and so on until all the small rectangular pieces are bent out to

serve as paddles; the spaces serve to admit the water upon the tube.

The sheet is now bent around a cylinder of a somewhat less diameter than the test tubes to be used. This gives the jacket a tension which enables it to grasp the tube firmly. By erecting the paddles in a direction corresponding to the cut of the chisel, the inner surface of the jacket is left smooth and does not scratch the glass in slipping it on or off.

For the support of the tube while under the shower bath I used two ceiling hooks which I screwed into a narrow board long enough to rest across the sink. They should be so levelled that the end of the tube containing the cotton plug will be very slightly elevated. The rapid motion will prevent the agar from gravitating down the tube while water will not run on to the plug.

In rolling the tubes the frame is drawn a trifle forward so that the stream of water passes in front of the frame, but just behind where the tube will rest. So soon as the tube is lifted from the warm water bath the jacket is slipped on, the tube then held horizontally, while the liquid agar is first distributed evenly in the usual way. Place it immediately on the supports as shown in figure 2, plate XI, then quickly slide the frame backward so that the water strikes the paddles when the tube immediately revolves as shown in figure 3, plate XI. The supports must not pinch the tube in the least else the friction will interfere with the freedom of the revolutions. The jacket and frame when not in use should be kept dry to prevent rust.

A little practice will determine the proper distance for the jacket from the end of the tube. It is best to have it a little nearer the bottom end of the tube and to allow the stream of water also to strike somewhat nearer the corresponding end of the jacket. This lessens the danger of wetting the cotton plug. As I have arranged mine, when running very rapidly the plug is kept dry.

In making the jacket due regard should be had for the size of the tube to be rolled. Within certain limits tubes of different diameters can be rolled with the same jacket since its elasticity permits some variation in its accommodation to the tube.

Alabama Polytechnic Institute, Auburn.

Noteworthy anatomical and physiological researches.

Gases in massive organs[1].

While this paper does not contribute very much that is new it is interesting as a careful record of experiment and as a verification of earlier researches. The author has availed himself of the more recent method of gas-analysis and brings out some interesting points, particularly regarding the pressure of internal atmospheres in plant-organs. In general his method is to produce an artificial chamber by perforating the fruit or tuber or root to be observed and in the *lacuna artificielle* thus produced to insert a tube, with the lower end sunk in a mercury-bath from the upper portion of which tube, as needed, a little gas can be taken for analysis. In this way it is possible to have under one's eye the changes that may take place and the differences, if any exist, between the internal and the external air are clearly distinguished. Potato-tubers and several fleshy fruits, those of various gourds and Rosaceæ, were studied with much care and an effort was made to discover not only the nature and pressure of the inclosed gases but to determine in what way these gases were distributed through the tissues, whether by diffusion, effusion (the movement through small channels) or by dialysis through membranes. Some of the general conclusions may be briefly transcribed here to indicate better the scope and extent of the researches.

1. The internal atmosphere of fleshy or massive organs is generally marked by a notable increase over the surrounding air in the proportion of oxygen, a feeble proportion of CO_2 and a slightly different proportion of nitrogen, which sometimes exceeds that in the outer air and sometimes does not, but is always rather close and slow to vary. 2. The internal pressure is almost always different from that of the outer air. Sometimes it is negative and sometimes positive but always in inverse proportion to the nitrogen. 3. The oxygen tends to be distributed through pores (effusion), but the CO_2 tends to be distributed through membranes (dialysis). 4. Humidity acts upon a massive organ in such a way as to increase its permeability while diminishing its porosity, and this is reflected in the changes in the pressure and composition of the internal gases. It tends therefore to a purifying of the air, in most cases, by the accumulation of oxygen and the throw-

[1] H. Devaux :—Ann. Sci. Nat. Botan., Ser. VII, xiv, 297–395.

ing off of CO_2. 5. Dessication acts in the reverse manner and, by diminishing the permeability, decreases the oxygen and tends to the storing up of a greater proportion of CO_2. 6. The nitrogen is passive and is carried as a by-product with the others. 7. The general conditions of gaseous interchange between fleshy plant structures and the rest of the plant or the outer air are best understood when we fix our attention upon the undoubted fact that there are three different kinds of interchange going on simultaneously, each of which is capable of modification by external or internal conditions. These are diffusion, effusion and dialysis.—CONWAY MACMILLAN.

Effects of electricity on growth.[1]

In this paper Hegler has described the effects of electricity on the growth of plants. In it he has shown that certain plants respond to electrical stimuli in a similar manner as they do to light. In his experiments he used an apparatus like that used by Hertz. Hertz has already demonstrated that electricity presents quite the same phenomena as light; that the electric beam can be polarized, focused, reflected and refracted.

The apparatus consists briefly of four Bunsen elements, which are connected by an interrupter with a very large induction apparatus, consisting of many thousand feet of coil; from this the current is transmitted to two brass knobs of 1.5 cm. radii, which constitute the poles, and between which the electric spark is made to pass at regular intervals. The brass knobs are placed about 10 cm. apart in a vertical direction, so that the transverse electrical waves fall on the long axis of the plant which is situated 1–2 cm. from the electric spark.

For these experiments Hegler found the rapidly growing aerial hyphæ of *Phycomyces nitens* particularly well adapted, as it is well known that they are exceedingly sensitive to all external influences. The plants were cultivated on sterilized bread and covered with a black paper cylinder to prevent heliotropic bendings. He found in from 3 to 6 hours the hyphæ bend away from the electric source, from which he maintains they are negatively electrotropic. The angle of bending, however, he found somewhat smaller than that produced by intense light. Herr Hegler also experimented with reflected rays, both from a plain and parabolic metal reflector, from which he obtained similar results.

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[1] ROBERT HEGLER:—Ueber die physiologische Wirkung der Hertz'schen Electricitætszellen auf Pflanzen. Leipzig.

When a cylindrical wire gauze was placed over the plant the hyphæ made no bendings, although a bell glass made no difference at all in their response to the electrical stimulation. — GEO. E. STONE.

The vegetation of the paramos of Venezuela.[1]

This paper contains a general sketch of the vegetation of the paramos with reference to the distribution and appearance of certain plants, and an account of the biology of these xerophilous plants.

Some of the Compositæ are characteristic of the paramo vegetation. Transpiration is diminished in these plants in different ways; for instance, by a dense cover of woolly hairs, by the development of coriaceous leaves, sometimes small in size and with involute margins, or by the development of merely short stems with densely leaved rosettes and underground reservoirs of nutritive matters. These characters are not, however, strictly separated, for more than one may be observed upon the same plant. Several other families besides the Compositæ show the same peculiarities.

The leaves of *Espeletia* have an immense cover of long white hairs, which are bent into broad spirals, so as to form a layer many times thicker than the leaf-blade itself. Thus the plant is well protected against a too rapid change in temperature, against the exsiccating effect of the winds, and has at the same time gained control of the transpiration. The leaf has a distinct hypoderm, which probably serves as a water-reservoir, and the inferior face shows several longitudinal ribs, which border on corresponding cavities in the leaf-blade. The chlorophyll-bearing parenchyma covers the furrows between the ribs, and there are in the interior part of the leaf wide openings, which remind us of lacunes, but which are covered with hairs and provided with stomata. These openings have been formed merely by a turning inwards of the surface of the leaf-blade. Of other paramo-plants with similar covering of hairs are mentioned a *Plantago*, a *Lupinus*, and especially the remarkable *Jamesonia nivea*. This last shows an aspect widely different from other ferns; the pinnules are horizontally spread out and cover each other as closely as the coins in a roll.

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[1] K. GOEBEL:—Die Vegetation der venezolanischen Paramos. Pflanzenbiologische Schilderungen, Pars 2. Marburg 1891.

Protection secured by diminishing the leaf surface is especially marked in a grass, *Aciachne pulvinata.* The blade is so strongly involute that the stomatiferous superior face is a mere furrow. The cells of the inferior epidermis are very thick walled and there are three layers of sclerenchyma inside the epidermis, all around the blade.

In some other plants the leaves are awl-shaped with the aspect of conifers or lycopods; such forms were observed in *Hedyotis nitida* HBK., which belongs to the Rubiaceæ; in *Lysipomia* of the Lobeliaceæ; and in *Phyllactis* of the Valerianaceæ; in species of *Alchemilla* and others.

There are, however, other peculiar forms of paramo-plants, which can not be arranged under any of the three above named groups; for instance some Umbelliferæ with leaves like those of a *Juncus*, namely *Ottoa*, *Crantzia*, etc.

Although these paramo-plants show the so-called xerophilous structure, the author calls attention to the fact, that a similar structure is also known in plants which do not belong there, but inhabit widely different localities. We therefore cannot always depend too much on structure in determining the character of the locality, because anatomical structure in this instance merely shows that the individuals live in a climate where a protection against transpiration has become necessary. This special vegetation seems to have been forced into its present shape for defence against stormy winds rather than extreme heat.—THEO. HOLM.

BRIEFER ARTICLES.

The identity of Asclepias stenophylla and Acerates auriculata.—(See p. 124 *ante.*) Correction must be made regarding the name recognized. There is an *Asclepias auriculata* Kunth. So Engelmann's *Asclepias auriculata* is not tenable. Dr. Gray's name, *Asclepias stenophylla*, must therefore stand. I hasten to make this correction, the more since I hesitated at the time in following the dictum that "the oldest available specific name" must stand. It seems to me, from this present experience, that to take up "the oldest available specific name *in the right genus*" is safer and less liable to reconsideration.—J. M. HOLZINGER, *Washington D. C.*

The embryo-sac of the Metaspermæ.—Hartog in the Dec. 1891 number of the *Quarterly Journal of Microscopical Science* suggests that the eight cells in the embryo-sac of the Metaspermæ are all to be considered as reproductive and follows the later view that the endosperm nucleus is a zygote. In a foot-note he retracts this position, in consequence of Guignard's work on the embryo-sac of *Lilium*. The writer a short time ago sent to the GAZETTE a statement of the same position as that first maintained by Hartog; but upon seeing his paper the preliminary note was withdrawn. In view of my own observation I am not, however, inclined to withdraw with Hartog from what seems to me the clear fact that the embryo-sac is, wherever we meet it, a *megaspore.* I do not think that the results of Guignard at all prevent us from holding to the view that the cells within the embryo-sac are, in Archispermæ and Metaspermæ alike, a female plant. At a later time I hope to discuss this point. In this brief note attention is directed to one fact which has escaped the late investigations, I believe. It is this: in the embryo-sacs of *Narcissus poeticus*, *Portulaca oleracea*, and *Cucurbita pepo* the micropylar nucleus, that is the sister nucleus of the egg, stains as does the *sperm* nucleus from the pollen-tube of the same species. The antipodal nucleus that fuses with this micropylar nucleus to form the definitive nucleus stains as an *egg*. That is to say, the micropylar nucleus stains about twice as quickly as the antipodal in both methyl-green and safranin. It has numerous, deeply stained chromatin bodies (chromosomes or chromatomeres) and the nucleoli are of a greater number than in the antipodal nucleus. In a number of other ways that might be named the antipodal nucleus reacts as an egg while the micropylar nucleus reacts as a sperm. It is clear that this can be explained either upon the hypothesis of Weissmann that the micropylar nucleus is histogenic, upon that of Hartog that it is an arrested gamete, or, best of all, upon that of Minot, Balfour and Van Beneden, that it is the male substance thrown off as a polar body and to make room for the similar but more distant substance of the sperm-nucleus. It is therefore improper to say as Hartog does that the definitive nucleus is a zygote, for there is a clear morphological distinction (that of size), beside the physiological one given, between the two fusing nuclei. Undoubtedly this fusion is a sexual act and the antipodal nucleus after it has been fertilised is enabled to pass into the segmentation phase and actually builds up a body, the endosperm, which is, however, always dependently situated with regard to the more virile,cross fertilised, embryo-producing egg-cell. The views of Warming, Mann,[1] Vesque, and Guignard, or the later view of Hartog, that these cells are any or

[1] See BOT. GAZETTE, this vol., p. 104.

all of them spores or the homologues of spores, seem to draw little support from the fact recorded. It is well said though by Hartog that the whole eight-cell group should be considered as egg-organs and not in any part as prothallium. I made this point in the note that was withdrawn, from a consideration of the staining phenomena mentioned above, and it seems not unlikely that it will be supported. It is very evident that the endosperm of the Metaspermæ is a different structure from that of the Archispermæ. It is probable that the two types are to be referred to different generations, that of the Archispermæ to the gametophytic and that of the Metaspermæ to the sporophytic.—CONWAY MACMILLAN, *University of Minnesota.*

A bit of the flora of Central Arizona.—During July and August of last year I was collecting plants and studying the flora of Central Arizona. While *en route* for Camp Verde by the old Black Cañon stage route between Phœnix and Prescott, I stopped for two days at Big Bug. This is a small mining camp and stage station some eighty miles north of Phœnix. During my sojourn here, I found in a deep cañon several miles northwest of the station as interesting a bit of flora as I have seen since coming to the territory.

As we leave the flat sandy desert, which extends for some distance north of Phœnix, and enter the mountainous region, there is almost an entire change in the floral aspect of the country. At this season of the year the only conspicuous vegetation on the sandy mesa that could be observed from the top of the stage coach were several species of cacti and the creosote bush, Larea Mexicana Moric. This shrub grows in nearly all parts of Southern Arizona, and is perfectly at home upon the driest mesa, where, in some years, it is without rain for several continuous months. It has surface roots and frequently grows upon a hard, rocky subsoil. No doubt the gum which covers the leaves like a coat of varnish aids greatly in retarding the evaporation of moisture.

Of the species of cacti found here, Cereus giganteus Engelm., Echinocactus Wislizeni Engelm., and the great tree cactus, Opuntia arborescens Engelm., are the first to catch the traveller's eye.

There is a marked variation in the forms of this latter species as found in the various parts of the territory. This variation is noticeable in length of spines, relative length of joints, color, and in the general aspect of the plant. It is possible that some of these forms may constitute varietal differences, or even specific ones, under more extended study.

As we reached the mountains, our route brought us to the Agua Fria River, which in July was almost dry. The banks of this stream,

together with its tributaries, were in many places covered with large clumps of Prunus demissa Wal. and Rhamnus Californica Esch., with now and then a large cottonwood or black willow showing above them. Platanus racemosa Nutt., Fraxinus pistaciæfolia Torr., and Juglans Californica Watson, were frequently seen nearly covered with the long and heavy vines of Vitis Arizonica Engelm., which grows in great abundance in nearly all the valleys of the territory. In many places the river bed was a complete tangle of Fallugia paradoxa Endlicher, Baccharis glutinosa Pers. and Baccharis salicina T. & G., while in the open places Petunia parviflora Juss., Chamæsaracha coronopus Gray, Euphorbia polycarpa Benth. var. aristida Watson, Euphorbia serpyllifolia Pers., Euphorbia albomarginata T. & G., Croton Texensis, Müll., Polanisia trachysperma T. & G. and Gaura parviflora Dougl., sprang up between the stones or out of the clear white sand. Extending back to the mountains on each side of the river was a dense chapparal of several varieties of Quercus undulatus Torr., densely loaded with acorns. In some localities these shrub oaks fruit so profusely that swine ranches are maintained upon the acorns alone. Mixed in with these oaks were found Arctostaphylos tomentosa, Dougl., Arctostaphylos Nevadensis Gray, Arctostaphylos pungens HBK., Acacia Greggii Gray, and Zizyphus lycioides Gray; while underneath them were growing Hedeoma Drummondii Benth., Verbena ciliata Benth., Mentzelia Wrightii Gray, and several species of Eriogonum. An Opuntia was occasionally seen, while here and there a Yucca baccata Torr. extended its long filamentous leaves in all directions, or an Agave Parryi Engelm. projected its scape high in the air. A few straggling spears of grass were found, mostly Bouteloua racemosa Lag. and Muhlenbergia Texana Thur. with a frequent bunch of Hilaria rigida Scrib. At this season the annuals were mostly scorched and destroyed by the prolonged drouth.

Traveling several miles northwestward from Big Bug, I entered the cañon to which I previously referred, and almost instantly found myself under the shade of Quercus Emoryi Torr., Alnus oblongifolia Torr., and Platanus racemosa Nutt. At either side, growing from the steep mountain slopes, were Juniperus Californica Carr. var. Utahensis Engelm., Juniperus pachyphlœa Torr., Pinus monophylla Torr. & Frem., and Canotia holacantha Torr. At my feet were many cones from Pinus ponderosa Dougl. which had been washed down by the stream from a dozen or more miles up the cañon.

Ascending the cañon, the banks of the stream on either side for rods are lined with the beautiful Aquilegia chrysantha Gray. Growing from the water were large bunches of Juncus tenuis Willd. and Scirpus pun-

gens Vahl., out of which were peeping the bright yellow flowers of Mimulus pilosus Watson. Here and there along the banks I gathered Nicotiana attenuata Torr., Nicotiana trigonophylla Dunal., Mimulus luteus L., Polygonum incarnatum Ell., Coreopsis cardaminaefolia Torr.& Gray, Asclepiodora decumbens Gray, Erythræa venusta Gray, Ambrosia psilostachya DC., Oxalis violacea L., Thalictrum Fendleri Engelm., Solidago Missouriensis Nutt., Solidago Canadensis L., Krameria parvifolia Benth., Aster ericæfolius Rothr., Viola Canadensis L.; var. scopulorum, Œnothera albicaulis Nutt., Polygala hemipterocarpa Gray, Petalostemon multiflorus Nutt., Bœrhaavia spicata Choisy, Solanum nigrum L., Erigeron divergens Torr. & Gray, Helianthus petiolaris Nutt., Riddellia Cooperi Gray, Nama hispidum Gray, and Maurandia Wizlizeni Engelm.

Further up the cañon the stream is shut in by almost perpendicular walls of rock. In many places where the water slowly seeps through small fissures in these rocky walls, Mimulus cardinalis Dougl., one of the most beautiful of wild flowers, was growing in abundance. Here also were found Mirabilis multiflora Desf., and Heuchera parvifolia Nutt. In many places large areas of Pteris aquilina L. spread their broad fronds in the shade of the protecting rocks.

On my return to the station, my plant-can contained more than seventy-five species in fit condition for herbarium specimens.—J. W. TOUMEY, *Tuscon, Arizona.*

EDITORIAL.

BOTANICAL AUTHORITY seems to be following the same lines of evolution as political. It began with a system of tyranny or dictatorship that vested all such authority in a single individual. Linnæus seems to have ruled the botanical world with a rod of iron, and his word was law. There next followed the reign of a botanical aristocracy, whose spirit was not merely to snub but even to suppress the work of the less favored. Naturally, the spirit of freedom and independence gradually increased, and numerous became the revolts against self-constituted authority.

OUR OWN country has passed through the period of a botanical aristocracy, and there is a good deal of written and unwritten history concerning rank injustice done to both worthy but unknown botanists and known but underrated botanists. A new generation, however, has come to the front; one in which the spirit of democracy is prevalent,

one that proposes to fight not only its own battles but also those of all ancient neglected worthies.

THE THING TO OBSERVE is that we are slipping rapidly away from the time when a few persons or a few places represented the concentration of botanical authority, and are upon the threshold of a new order of things in which the voice of authority is to come from "the people." There may not be greater rivalry in feeling, but there will be far more successful rivalry; and the botanical landscape will represent a uniform forest rather than a cluster of sequoias towering in the midst of their lowly neighbors. Everything wrought out will have to run the gauntlet of the many instead of the few.

THIS CONDITION of things has been brought about by the wonderful spread of scientific training and the consequent development of independent thinking. In a general sense this is a far more desirable state of affairs, for it develops hundreds of efficient workers where there was only one before. It also has certain disadvantages common to all democracy. While it brings individual freedom it permits follies which a strong central power would have repressed. The new order of things, therefore, must be expected to be more of a "lo here" and "lo there" state of affairs, full of "fads" and erratic movements, and abounding more in worthless than worthy literature, but there is in it more of hope and promise for the rapid development of botanical science than under the former régime, for an aristocracy is always inclined to be ultra-conservative. It is only rebels who are apt to be extremists, and when there is nothing left to rebel against they usually settle down into staid and comfortable citizens.

OPEN LETTERS.

The pollination of Orchis spectabilis.

In the spring of 1891 while examining Orchis spectabilis, I was surprised to see the pollen masses, which I had withdrawn on the point of my pencil, turning backward, instead of downward, as one would expect from the position of the stigma below the anthers. When I pushed the pencil point into another flowers the pollen masses were quite out of position to fertilize the pistil. Yet this flower is said to set seed abundantly. Can any of the readers of the GAZETTE throw light upon the matter?—JANE H. NEWELL, *Cambridge, Mass.*

NOTES AND NEWS.

MR. W. W. CALKINS returned to Chicago from his collecting trip in Tennessee May 1.

A MONOGRAPH of the Myxoga stres covering 367 octavo pages and illustrated with twelve colored plates has recently been published by Mr. George Massee.

THE MARINE BIOLOGICAL LABORATORY at Wood's Holl opens its fifth season June 1. The botanical instruction will he in charge of Mr. W. A. Setchell of Yale University.

DR. F. ELFVING, of the University of Helsingfors, and Dr. M. Möbius, of the University of Heidelberg, have each been promoted from docent to a professorship in their respective institutions.

DR. J. C. ARTHUR sails for Europe June 4, for a two months' trip, principally in Germany. He goes largely to ascertain the possibilities and promote the interests of the Botanical Congress of 1893.

THE HERBARIUM of the University of Minnesota is growing so rapidly that the item published in the March number was out of date. That collection now contains upward of 60,000 plants, of which 25,000 are spermaphytes.

MM. L. MESCHINELLI AND S. SQUINABOL propose to publish, if sufficient encouragement thereto is offered, a work which is ready for press, on the Tertiary flora of Italy. 114 genera of cryptogams and 333 of phanerogams are known from this formation in Italy.

MR. WALTER H. EVANS is now in Arizona, in the employ of the Department of Agriculture, collecting living desert plants for the Columbian Exposition. It is the purpose of the Department to represent as completely as possible the characteristic vegetation of our southwestern arid regions.

AN APPRECIATIVE sketch of Sereno Watson appears in the *Bull. Torr. Bot. Club* (April) from the pen of Mr. Walter Deane. Mr. Deane is peculiarly qualified to write concerning Dr. Watson, as their intimate personal acquaintance brought the subject very often under the observation of the writer.

DR. THOS. C. PORTER has just described (*Bull. Torr. Bot. Club*, April) two new Eupatoriums, one from Tennessee, the other from New Jersey; four new varieties of as many species of Solidago; a new species of Solidago whose name, S. Roanensis, suggests its habitat; and a new Tripsacum from Florida.

THE DISAPPEARANCE of *Desmodium* from our flora, threatened by a botanist who curiously enough can sign himself "O. K.," is emphasized by Anna M. Vail in *Bulletin of Torrey Botanical Club* (April), who presents the synonymy of the genus *Meibomia*, as it occurs in the United States and British America.

THE PRINCIPAL ARTICLE in the last number of *Flora* (1892, Heft 2) is on the photometric movements of plants by F. Oltmanns. Shorter articles are by J. Sachs, physiological notes, A. Doyel on the morphology and development of the starch grains of Pellionia, and F. Noll on the culture of marine algæ in aquaria.

FLORA FRANCISCANA, Part III, presents the following orders and sequence: Papaveraceæ, Nymphæeæ, Sarraceneæ, Droesereae, Laurineae, Berberideae, Ranunculaceae, Sarmentosae (Vitaceae), Araliaceae, Umbelliferae, Corneae, Elaeagneae, Daphnoideae (Thymelaeaceae), Santalaceae, Lorantheae, Caprifoliaceae, Rubiaceae, Valerianeae.

THE USUAL summer courses in botany at Harvard University are announced. Mr. W. F. Ganong and Mr. G. J. Pierce will conduct two courses each in morphology and physiology and in histology, while Mr. A. B. Seymour offers (for advanced students only) two courses, one in general cryptogamic botany and one in economic mycology.

MESSRS. J. K. SMALL and Luther D. Reed will make a botanical expedition during the coming season from the southwestern corner of Virginia to the Mississippi river along the southern border of Kentucky. The region is a rich collecting field but little explored. Those desiring to arrange for the purchase of sets of specimens can address Mr. Reed at Lancaster, Pa.

MR. JOHN S. WRIGHT has accepted the position of botanist in the pharmaceutical establishment of Eli Lilly & Sons, Indianapolis, Ind., as successor to Walter H. Evans, who resigned to take a position in the botanical division of the U. S. Department of Agriculture. Mr. Wright enters upon his duties in June at the completion of his undergraduate studies in Purdue University.

THE SECRETARY of the Society for the Promotion of Agricultural Science has decided to postpone the publication of the proceedings of the society for 1891 until after the next meeting, which occurs in August. The unfortunate delay is necessitated by the failure of the printing firm having the contract to resume work since their establishment was destroyed by fire in January last.

IN THE SUMMER SCHOOL of the University of Wisconsin, courses in botany planned with special reference to high school teachers are offered. One is a "model course," embracing instruction in the method and on the topics which Prof. Barnes thinks desirable and practicable in high schools having limited equipment. Advanced work in anatomy is also offered.

SOME IDEA of the growing attractiveness of the Royal Gardens at Kew may be obtained from the report of the number of visitors in each decennial year, a record which now covers 50 years. In 1841 there were 9,174 visitors; in 1851, 327,900; in 1861, 480,070; in 1871, 577,084; in 1881, 836,676; in 1891, 1,373,753. On a single holiday, (May 26, 1890), the attendance was 106,808.

DR. J. H. SANDBERG, Messrs. D. T. MacDougal and A. A. Heller have gone to Idaho under the auspices of the Botanical Division of the Department of Agriculture to make an extended botanical exploration along the Clear Water river, the Nez Perces Reservation, thence northward to the Bitter Root mountains, and down into the Clark Fork of the Columbia river. Their headquarters are at Lewiston, Idaho.

THE EXPEDITION TO WESTERN AFRICA under the direction of Mr. O. F. Cook, of Syracuse University, has been unfortunate and has accomplished much less than anticipated on account of tropical fever.

Every member of the company has been ill, necessitating a complete change in the original plans. Mr. Cook expects to again attempt to penetrate the interior of Moravia, and then return to America the coming August. The other members of the expedition will probably return sooner.

THE CONSTITUTION and list of members of the Ohio Academy of Sciences have been issued as a twelve-page pamphlet. The Academy was organized Dec. 31, 1891, with fifty-four charter members. The Nebraska Academy of Sciences was organized Jan. 1, 1891, with forty charter members. It has published the constitution and list of members in an eight-page pamphlet, and more recently a twenty-four page pamphlet containing abstracts of papers read at the second annual meeting Dec. 31, 1891, largely botanical.

THE ITALIAN BOTANICAL SOCIETY on behalf of the city of Genoa, Italy, invites the botanists of every nationality to a Botanical International Congress to be held Sept. 4 to 11, 1892, in commemoration of the fourth centennial of the discoveries of Columbus, a citizen of Genoa. It will alsobe the occasion of the opening of a new Botanical Institute and of a horticultural exhibition. Excursions and other festivities are offered by the municipality of Genoa and also by the Botanical Society. It is hoped to make the gathering truly cosmopolitan.

THE JOURNAL OF MYCOLOGY, issued by the Division of Vegetable Pathology of the U. S. Department of Agriculture, is constantly increasing in size and interest. The last number contains seventy pages of original matter on plant diseases and new species of fungi, illustrated with seven plates and several text cuts. Seven publications are reviewed at considerable length, and the number closes with forty-two pages of index to current literature. This index is a most commendable and useful feature and especially as at present conducted. The citations are followed in each case by a brief résumé of contents of the work. The Chief of the Division thoughtfully offers to supply extra copies of the index to those who wish to arrange the numbers in a card catalogue.

AN UNUSUAL NUMBER of Experiment Station bulletins containing botanical matter have been issued in the last month. The Arizona Station proposes (No. 5) to make a study of the native Rumex hymenosepalus, locally known as cañaigre, as a tannin producing plant. F. H. Hillman (Nev., No. 15) describes and illustrates Cuscuta epithymum, C. arvensis, and C. denticulata as pests of alfalfa (Medicago sativa). Fungous diseases of plants and their treatment are discussed by W. C. Sturgis (Conn., No. 111), L. H. Pammel (Iowa, No. 16), S. A. Beach (N. Y., No. 40), S. T. Maynard (Hatch, No. 17), J. C. Arthur (Ind., No. 39) and C. F. Millspaugh (W. Va., No. 21). Geo. F. Atkinson (Ala., No. 36) gives an interesting and extended account of his study of yellow leaf blight of cotton, a physiological disease. The annual reports of New Jersey (1890), Connecticut (1891) and Indiana (1891) Stations also contain matter on plant diseases by B. D. Halsted, R. Thaxter and J. C. Arthur respectively. Nearly all of these articles are well illustrated.

BOTANICAL GAZETTE

JUNE, 1892.

On nomenclature.

SERENO WATSON.

[It was the request of the late Dr. Sereno Watson that the following communication, dictated by him in his last illness, should appear at an early date in the BOTANICAL GAZETTE.— EDS.]

For some time I have had a desire to give expression to my views upon botanical nomenclature. Under the circumstances, I must speak briefly and somewhat dogmatically. In my opinion botany is the science of plants and not the science of names. Nomenclature is only one of those tools which is necessary to botany, and this being the case, points of nomenclature should be subordinated to science.

A principle of botanical convenience has been established by those who prefer one name to another on account of expediency or convenience. This principle should have a great deal of influence. It has been so recognized by the greatest botanists, and from their authority receives great weight. I prefer the word *expediency* as a better term than convenience to designate the principle, that the demands of science override any merely technical claims of priority, etc.

Priority of specific names appears to be based entirely upon one section of the code of 1867. That simply says that when a species is transferred from one genus to another, the specific name is maintained. This principle is usually understood and applied in the way that the oldest specific name has a right in all cases to be retained. It cannot fairly be so interpreted and applied, since it governs only to the extent that this should be the law, but it is not to be made an *ex post facto* law. Thus when a transfer has been made, that ends the matter so far as the choice of a specific name is concerned, and no one is authorized to take up a different name. This practice of retaining the oldest name *under the genus*, no matter what older specific names there may be, was adopted by Dr. Gray in his later years and by the Kew bot-

anists, for the reason that once established and pretty generally recognized, it would avoid the great mass of synonymy, which is being heaped like an incubus upon the science. I must express surprise that Dr. Britton has not considered it his duty to publish the last written words of Dr. Gray which were addressed to him upon this subject and which expressed his positive opinions upon this point.

There is nothing whatever of an ethical character inherent in a name through any priority of publication or position which should render it morally obligatory upon anyone to accept one name rather than another; otherwise it would be applicable or true as well in the case of ordinal names, morphological names, teratological, and every other form of name, to which now no one feels himself bound to apply the law of priority. The application of this law as at present practiced by many botanists, which would make it the one great law of botanical nomenclature, before which every other must yield regardless even of common sense, is a mere form of fetichism exemplified in science. Many instances of the application of this law are not science but are rather superstition.

February 22, 1892.

The North American Lejeuneæ.

F. STEPHANI.

In his Descriptive Catalogue of N. A. Hepaticæ Dr. Underwood has collected the names of all Lejeuneæ reported to have been found in the United States and Canada. Amongst these are four species, which Taylor published as having come from Cincinnati, while they had been collected on the shores of the Amazon, near the city of Pará, which Taylor believed to be a place in the vicinity of Cincinnati. These four species are *Lej. cyclostipa*, *polyphylla*, *testudinea* and *longiflora*, all of which having been described before, now bear other names. His *Lejeunea calyculata* too is merely the common form of *Lej. clypeata* Schweinitz. There remain only the following species, to which I have added four newly detected plants: *Lej. trifaria* Nees, *Lej. Wrightii* G., *Lej. Cardoti* Steph., *Lej. Underwoodii* Steph. The North American Lejeuneæ have to be arranged as follows:

a. Holostipæ.

1. *Neuro-Lejeunea catenulata* Nees: a most beautiful little plant and well described, page 323, in Synopsis Hepaticarum.

2. *Archi-Lejeunea clypeata* Schweinitz.
Syn.: *Lej. calyculata* Taylor.

3. *Archi-Lejeunea xanthocarpa* L. & L.: quite different from *Lej. catenulata* to which it has not the least resemblance.

4. *Mastigo-Lejeunea auriculata* Hook. & Wils.
Syn.: *Phragmicoma versicolor* L. & L.

5. *Lejeunea Mohrii* Austin, which I have not seen.

b. Schizostipæ.

6. *Euosmo-Lejeunea trifaria* Nees: newly detected in Florida, in large tufts on bark of trees.

7. *Eu-Lejeunea Austini* Lindb.

8. *Eu-Lejeunea Caroliniana* Aust.

9. *Eu-Lejeunea serpyllifolia* Libert.

10. *Eu-Lejeunea Underwoodii* Steph. n. sp.

11. *Micro-Lejeunea Cardoti* Steph. n. sp.

12. *Micro-Lejeunea lucens* Taylor: not at all identical with *Lej. cucullata* Nees, which looks more like *Lej. minutissima.*

13. *Micro-Lejeunea ulicina* Taylor: Lindberg found this in a tuft of *Lej. serpyllifolia* from Charleston; see his Hepaticæ in Hibernia lectæ, page 482. Taylor gave this name to a minute plant with stipules, while *Lej. minutissima* Smith has none; the synonymy has been much confused and even Lindberg has fallen into errors, which Spruce has already corrected. I wish to repeat, therefore, that Lindberg's *Lej. inconspicua* is the true *Lej. minutissima* while his *Lej. minutissima* is *Lej. ulicina.*

14. *Colo-Lejeunea calcarea* Libert (1820): a name for which Lindberg has substituted Taylor's name *Lej. echinata*, which was not given before 1844. Hooker published this plant as *Jungermania hamatifolia*, var. *echinata;* Mme. Libert, recognizing it as a distinct species was not obliged to use the name echinata. Lindberg in doing so, wronged the old author and multiplied the names without any necessity. Spruce in his admirable work on the Hepaticæ Amazonicæ et Andinæ, page 292, uses the name *Lej. calcarea* Libert.

15. *Colo-Lejeunea Jooriana* Aust. I have not seen.

16. *Colo-Lejeunea minutissima* (Smith.)
Syn.: *Lejeunea inconspicua* De Notaris.

17. *Colo-Lejeunea parvula* Aust. I have not seen. See Lindberg l. c. page 481.

18. *Colo-Lejeunea Wrightii* Gottsche: this plant, growing on bark of living trees, has been sent me from Louisiana, leg. Langlois. It was known before from Cuba, and together with *Lej. trifaria*, *L. auriculata* and *L. xanthocarpa*, is largely distributed throughout tropical America. The last species is found also throughout Africa, where it has been found on the slopes of the Kilimandscharo, in the island of Fernando Po opposite Cameroon and also at the Cape of Good Hope. Truly an extensive distribution!

There remain two species, which I have never seen and the suborder of which is not to be recognized from the descriptions; these are

19. *Lejeunea laete-fusca* Austin.

20. *Lejeunea Ravenelii* Austin.

I conclude by giving the descriptions of the before named new species viz.:

Micro-Lejeunea Cardoti n. sp.—Dioica, exigua, dense caespitosa, viridis. *Caulis* multiramosus, ramis recte patentibus, filiformibus. *Folia* normaliter late ovata, oblique patentia, dorso longe soluta, ventre grandilobulata, *lobulus* inflatus apice excisus, hamatim longe dentatus. Folii *cellulae* 1 . Incrassatis angulosa nulla. Ocella 3 ad basin folii 0.017×0.025 mm. Plurima folia lobulos reductos, plicaeformes, ostendunt. *Amphigastria* ovata, usque ad basin fere bifida, laciniis lanceolatis. Flores feminei pseudolaterales; *folia floralia* subaequaliter biloba, conduplicato-concava, lobis brevibus obtusis. *Amphigastrium florale* foliis suis aequilongum, ovatum, ad $\frac{1}{3}$ bifidum, lobis obtusis. *Perianthium* pyriforme, *inflato-quinquangulare*, rostro subnullo.

Proxima *Lejeuneae ulicinae*, quae differt foliis fere rotundis, dorso longius accretis, foliorum lobulo multo majore, dimidium folii tegente, cellulis distincte incrassatis. *Lejeunea bullata* Taylor differt foliis fere erectis, ellipticis. *Lejeunea lucens* T. multo major est et toto coelo diversa.

HAB.: Louisiana (*Langlois*). Mexico (*Pringle*).

Eu-Lejeunea Underwoodii n. sp.—Dioica, flavicans, dense depresso caespitosa, minor. *Caulis* vage ramosus, flaccidus. *Folia* subplana, late ovata, oblique a caule patentia, antice caulem tegentia haud superantia, apice *angulato-repanda*. *Cellulae* foliorum margine 0.012 mm., medianae 0.017 mm.,

basales 0.017×0.025 mm., *trigonis magnis acutis*. *Lobulus* diametro caulis duplo longior, decurrens, carina arcuata sinu lunato in folium excurrente, apice exciso-truncatus, angulo brevidentato, ceterum valde convexus, margine supero involuto. *Amphigastria* caulina ovata, caule plus duplo latiora, ad medium fere bifida, sinu angusto laciniis acutis. *Flores feminei* in caule ramisque pseudolaterales, raro in angulo furcarum. *Folia floralia* caulinis minora, arcuatim divergentia, e basi angusta falcato-oblonga, lobulo lanceolato profunde soluto, acuto. *Amphigastrium florale* foliis suis aequimagnum, oblongum, ad ⅓ incisum, rima angusta, laciniis muticis.

Perianthia et *androecia* ignota.

HAB.: Florida (*Underwood*). *Lejeunea Caroliniana* monoica est. *Lejeunea Austini* cellulis multo minoribus gaudet. A remarkable feature in this plant is the *large incrassations* at the angles of the cells, which form very distinct triangles with acuminate points.

Kaiser Wilhelm str. 9., Leipzig, Germany.

Flowers and insects. VIII.

CHARLES ROBERTSON.

ISOPYRUM BITERNATUM Torr. & Gray.—The plants grow in damp, rich woods, in small patches, notably about bases of trees. The stem rises a few inches and bears a few-flowered cyme, in which only one or two flowers are open at the same time.

The flowers are white, sometimes with a purplish tinge; they are strongly heliotropic and measure about 14 or 15 mm. across, the five oval petals expanding horizontally. The stamens are numerous, the outer elongating and discharging pollen first. Nectar is probably secreted by the bases of the filaments; insects probe among them with their proboscides, evidently for nectar. The four styles at first overtop the inner stamens, and have receptive stigmas before any of the anthers discharge, so that the flower is female in the first stage.

When the cyme contains two open flowers, one of them is commonly in the male, the other in the female stage. In case of insect visits, the latter is more apt to receive pollen from another stem, but may receive it from the older flower

on the same stem. If the stigmas are not pollinated before the outer anthers begin to dehisce, they might receive pollen from them by insect aid or by the closing of the petals. Later, when the inner anthers discharge, if the stigmas remain unfertilized, they may receive pollen falling from the anthers which now overtop them. But insects are by far the most important agents in effecting self-pollination, which, however, I think is the exception.

The flowers remain open all day and open on two or three successive days. For the attention of insects the plant is in strong competition with a number of plants, most of which have the advantage, especially *Claytonia Virginica*, which is much more abundant and more attractive.

The flower is adapted to short-tongued bees and flies, which come for both honey and pollen. It seems especially attractive to bees of the genus *Halictus;* the list shows all of the early-flying species I have found in my neighborhood, except *H. ligatus* and *confusus*, and more species than I have ever found on any other flower.

I have found the flowers in bloom from March 24 to May 12. On twelve days, between March 26 and April 25, I observed the following visitors:

Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, s. & c. p., freq.; (2) Bombus americanorum F. ♀, s., one; (3) Synhalonia honesta Cr. ♂, s., one; (4) Ceratina tejonensis Cr. ♂, s.; (5) C. dupla Say ♂, s.; (6) Osmia albiventris Cr. ♂ ♀, s.; (7) Nomada bisignata Say ♂ ♀, s.; *Andrenidae:* (8) Andrena bicolor F. ♂ ♀, s., freq.; (9) A. sayi Rob. ♂ ♀, s.; (10) A. erigeniae Rob. ♂ ♀, s.; (11) A. flavo-clypeata Sm. ♀, c. p.; (12) A. rugosa Rob. ♂ ♀, s.; (13) A. forbesii Rob. ♀, s.; (14) A. claytoniae Rob. ♂, s.; (15) Agapostemon radiatus Say ♀, s.; (16) Augochlora labrosa Say ♀, s.; (17) A. pura Say ♀, s.; (18) Halictus gracilis Rob. ♀, s.; (19) H. 4-maculatus Rob. ♀, s.; (20) H. pectoralis Sm. ♀, s.; (21) H. coriaceus Sm. ♀, s.; (22) H. forbesii Rob. ♀, s.; (23) H. lerouxii Lep. ♀, s. & c. p.; (24) H. fasciatus Nyl. ♀, s. & c. p., ab.; (25) H. cressonii Rob. ♀, s.; (26) H. pilosus Sm. ♀, s.; (27) H. obscurus Rob. ♀, s. & c. p., ab.; (28) H. stultus Cr. ♀, s., c. p., f. p.; (29) H. zephyrus Sm. ♀, s., ab.; (30) H. imitatus Sm. ♀, s., one; (31) Colletes inaequalis Say ♂, s.

Diptera—*Bombylidae:* (32) Bombylius fratellus Wd., s., ab.; *Empidae:* (33) Empis sp., s., one; *Syrphidae:* (34) Chil-

osia capillata Lw.; (35) Melanostoma obscurum Say; (36) Syrphus ribesii L.; (37) S. americanus Wd.; (38) Mesograpta marginata Say; (39) M. geminata Say; (40) Sphaerophoria cylindrica Say; (41) Eristalis dimidiatus Wd.; (42) Helophilus similis Mcq.; (43) Xylota fraudulosa Lw.—all s. & f. p.; *Tachinidae:* (44) Gonia frontosa Say, s.; *Muscidae:* (45) Lucilia cornicina F., s.

Coleoptera—*Coccinellidae:* (46) Megilla maculata DeG., f. p., one; *Chrysomelidae:* (47) Diabrotica vittata F., f. p., one; *Œdemeridae:* (48) Asclera ruficollis Say, f. p.; *Anthicidae:* (49) Corphyra terminalis Say, f. p.

Hemiptera—*Capsidae:* (50) Lygus pratensis L., s., one.

SANGUINARIA CANADENSIS L.—This is a common plant of wide distribution. In my neighborhood, however, it is rather rare; at any rate, I know of but a few stations for it.

Each plant bears a single scape rising about one decimeter and supporting an 8 to 12-petaled, white flower, which expands about 4 or 5 cm. The plants are sometimes collected in little clusters, so that the flowers are made quite conspicuous and must attract insects from a distance. In the morning the petals are expanded horizontally, but in the afternoon they become more erect, preparatory to closing.

The flowers are female in the first stage. On the first day of opening, the large, two-lobed stigma is receptive, while the anthers are still closed. By the time the anthers are beginning to discharge, the stigma has turned brown, its papillae appearing shriveled.

The numerous stamens are of unequal length, the outer being much shorter. The tips of the inner anthers sometimes barely rise as high as the stigma, in which case, provided pollination has not previously occurred, the stigma might receive a little pollen from the surrounding anthers. The pollen is the attraction for insects, although I have seen hive-bees and *Bombylius fratellus* Wd. vainly probing for nectar about the base of the ovary.

The newly opened flowers are smaller and less widely expanded. Insects land upon them, dusting their stigmas before perceiving that the anthers are indehiscent. The result is cross-fertilization between distinct plants.

In competition with *Sanguinaria* are *Anemonella thalic-*

troides, *Isopyrum biternatum*, *Claytonia Virginica*, *Erigenia bulbosa* and *Erythronium albidum*, all of which have the advantage.

The flowers are monopolized by hive-bees, which collect the pollen so effectually that it is very difficult to find out what were the normal visitors of the flower. There is little doubt, however, that the plant originally depended for fertilization mainly upon the aid of bees of the genera *Halictus* and *Andrena* and flies of the family *Syrphidae.*

I have found the flowers in bloom from April 2 to 13. On April 13 I noted the following visitors:

Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, c. p., ab.; *Andrenidae:* (2) Halictus zephyrus Sm. ♀, c. p.; (3) H. stultus Cr. ♀, c. p.

Diptera—*Syrphidae:* (4) Syrphus sp., f. p.

Coleoptera—*Œdemeridae:* (5) Asclera ruficollis Say, f. p., freq.

I also saw several individuals of *Andrena bicolor* F. ♂ flying about the flowers in search of the female, which is probably a visitor.

At Madison, Wisconsin, May 9, Professor Trelease found the flower visited for pollen by *Andrena bicolor* F. ♀ and *Halictus confusus* Sm. ♀.

BAPTISIA LEUCOPHAEA Nutt.—This plant is rare in my neighborhood; I know of but one station for it, on creek bluffs. The stems rise about a foot from the ground, are diffusely branched and bear large, drooping racemes of handsome, cream-colored flowers.

The calyx tube measures about 5 or 6 mm. and serves to hold the petals so that they can not easily be separated by intruders. The banner runs forward for about 14 mm. when it rises nearly straight upwards. Its blade measures 20 mm. or more in breadth, and is not so strongly reflexed at the sides as in *B. leucantha.* The wings extend forward and conceal the keel. At the base above, the blade is inflected upon a gibbosity upon the base of the keel, with the result that, when a bee lands upon the flower, it depresses both wings and keel.

The stamens are distinct. Since there is is no special opening at the base to admit the bee's tongue, as in the diadel-

phous Papilionaceae, the bee inserts its proboscis between the upper filaments. The filaments are somewhat unequal in length. The anthers dehisce in succession, so that to remove all of the pollen, bees must visit each flower several times. The stigma is situated among the anthers, and I find nothing to prevent self-pollination. The flower has more accessible nectar than in B. leucantha, but on account of its early blooming, it has less need of adaptation to exclude shorter tongues, since it is mostly exposed to *Bombus* females and species of *Synhalonia.*

Osmia latitarsis was the only bee visiting it for both honey and pollen, and there may be an important relation between the flower and the bee, which are both equally rare. I have as yet taken the female of this *Osmia* only on the present flower.

The following list of visitors was observed on May 16 and 19:

Apidae: (1) Bombus separatus Cr. ♀, s.; (2) B. americanorum F. ♀, s.; (3) Synhalonia speciosa Cr. ♀, s.; (4) Osmia latitarsis Cr. ♀, s. & c. p.

TRIFOLIUM PRATENSE L.—("Adv. from Eu.")—I have been much interested in observing how frequently this well-known bumble-bee flower is visited by Lepidoptera. It is a common thing for bee-flowers to be visited to some extent by butter-flies, but this seems to me to be an unusual case. In Germany, Müller found it visited by 8 Lepidoptera in a list of 39 insects, while in Illinois I have found it visited by 13 species in a list of 20. Our flowers are exposed to a richer butterfly-fauna, so that we may expect to find a larger proportion of butterflies upon them, and the differences between bee and butterfly-flowers may not be so well indicated in the lists of visitors.

But while butterflies may sometimes effect cross-fertilization of the red clover, they are of doubtful value, if not injurious. Bumble-bees depress the keel so that their heads and proboscides are well dusted with pollen. But butterflies can insert their thin tongues without depressing the keel, and, even if they get a little pollen on their thin proboscides, it is apt to be wiped off by the closely approximated tips of the petals, which close the mouth of the flower.

I have found it in bloom from April 26 to Nov. 4. On 15 days, May 10 to Sept. 11, I noted as visitors:

Hymenoptera—*Apidae:* (1) Bombus ridingsii Cr. ♂, once; (2) B. separatus Cr. ♂ ♀ ☿, ab.; (3) B. pennsylvanicus DeG. ♀ ☿, ab.; (4) B. americanorum F. ♂ ♀ ☿, very ab.; (5) B. vagans Sm. ☿, s., one; (6) Anthophora abrupta Say ♂ ♀.

Lepidoptera—*Rhopalocera:* (7) Danais archippus F.; (8) Argynnis cybele F.; (9) Pyrameis atalanta L.; (10) P. huntera F.; (11) P. cardui L.; (12) Lycaena comyntas Godt.; (13) Papilio cresphontes Cram.; (14) Pieris rapae L.; (15) Callidryas eubule L.; (16) Pamphila peckius Kby.; (17) P. cernes B.-L.; (18) Eudamus tityrus F.; *Sphingidae:* (19) Hemaris axillaris G.-R.

Birds—*Trochilidae:* (20) Trochilus colubris L., thrice.

The following table gives the visitors which have been observed sucking the flowers in the normal way:

REGION.	Bombus.	Anthophora.	Eucera.	Anthidium.	Megachile.	Osmia.	Bombylius.	Lepidoptera.	Trochilus.	Total.
1. In Low Germany—Müller,[1]...	12	1	1	1	1	1	8	..	..	25
2. In the Pyrenees—MacLeod,[2]..	6	1	..	..	..	..	1	11	..	19
3. In Illinois....................	5	1	..	..	..	..	..	13	1	20

HEUCHERA HISPIDA Ph.—Each plant of this common species bears several scapes, which rise 6 to 9 dm., and bear long panicles of greenish flowers.

The calyx is oblique, being quite gibbous on the lower side. It measures about 6 mm. in length, the lobes being directed forward and a little inward and the petals filling the intervals, so that the effect is much the same as if the parts were united to their tips. The tube is very broad, measuring about 4 mm. wide, so that it readily admits the head and thorax of a bee.

The stamens lengthen and discharge pollen in succession, beginning with the upper one. Accordingly, to collect all of the pollen, the flower must be visited several times.

The flowers are proterogynous[3] with long-lived stigmas, and are remarkable for being visited exclusively by a species

[1] Fertilization of Flowers. [2] Pyreneënbloemen. [3] Müller, Fertilization of Flowers, 243.

of *Colletes*, *C. heucherae* Rob., the females coming for honey and pollen, and the males for honey and in search of the females.

It blooms from May 11 to June 29.

LYTHRUM ALATUM Ph.—The plants are common in wet places. The stems grow 4 or 5 dm. high, are much branched and bear many loose racemes of purple flowers. The six petals are each marked with a reddish line leading to the base. They expand so that the flowers measure 15 mm. across.

The dimorphism of the flowers was first recorded by Halsted in the Bulletin of the Iowa Agricultural College, 1888. In the short-styled form the stigma reaches the throat of the calyx tube, and the stamens are exserted from 3 to 4 mm. In the long-styled form the stigma is exserted about 3 mm., and the anthers only reach the throat. In this form the stamens are variable, sometimes giving an appearance of trimorphism; but the unequal length seems only to prevent crowding of the anthers in the narrow tube.

The plants often grow in large patches, which renders them quite conspicuous, and very attractive to insects. The calyx-tube is narrow and measures 5 or 6 mm. in length, which restricts the visitors to long tongues. The principal visitors are butterflies. On 12 days, June 18—Aug. 18, the following list was observed:

Hymenoptera—*Apidae:* (1) Bombus virginicus Oliv. ☿, s. & c. p., freq.; (2) Melissodes bimaculata Lep. ♂, s., freq.; (3) Megachile petulans Cr. ♂, s.; (4) M. brevis Say, ♂ ♀, s., freq.; (5) Coelioxys 8-dentata Say ♀, s.; (6) Epeolus lunatus Say ♀, s.; *Andrenidae:* (7) Agapostemon nigricornis F. ♀, s.

Lepidoptera—*Rhopalocera:* (8) Pieris protodice B.-L.; (9) P. rapae L.; (10) Colias philodice Godt.; (11) Pyrameis cardui L.; (12) Chrysophanus thoe B.-L.; (13) Pamphila peckius Kby.; (14) P. cernes B.-L.; (15) Pholisora catullus F.—all s.

Diptera—*Bombylidae:* (16) Systoechus vulgaris Lw.; (17) Exoprosopa fasciata Mcq.; (18) E. fascipennis Say—all s.; *Syrphidae:* (19) Helophilus latifrons Lw.; (20) Tropidia quadrata Say—both f. p.

Carlinville, Ill.

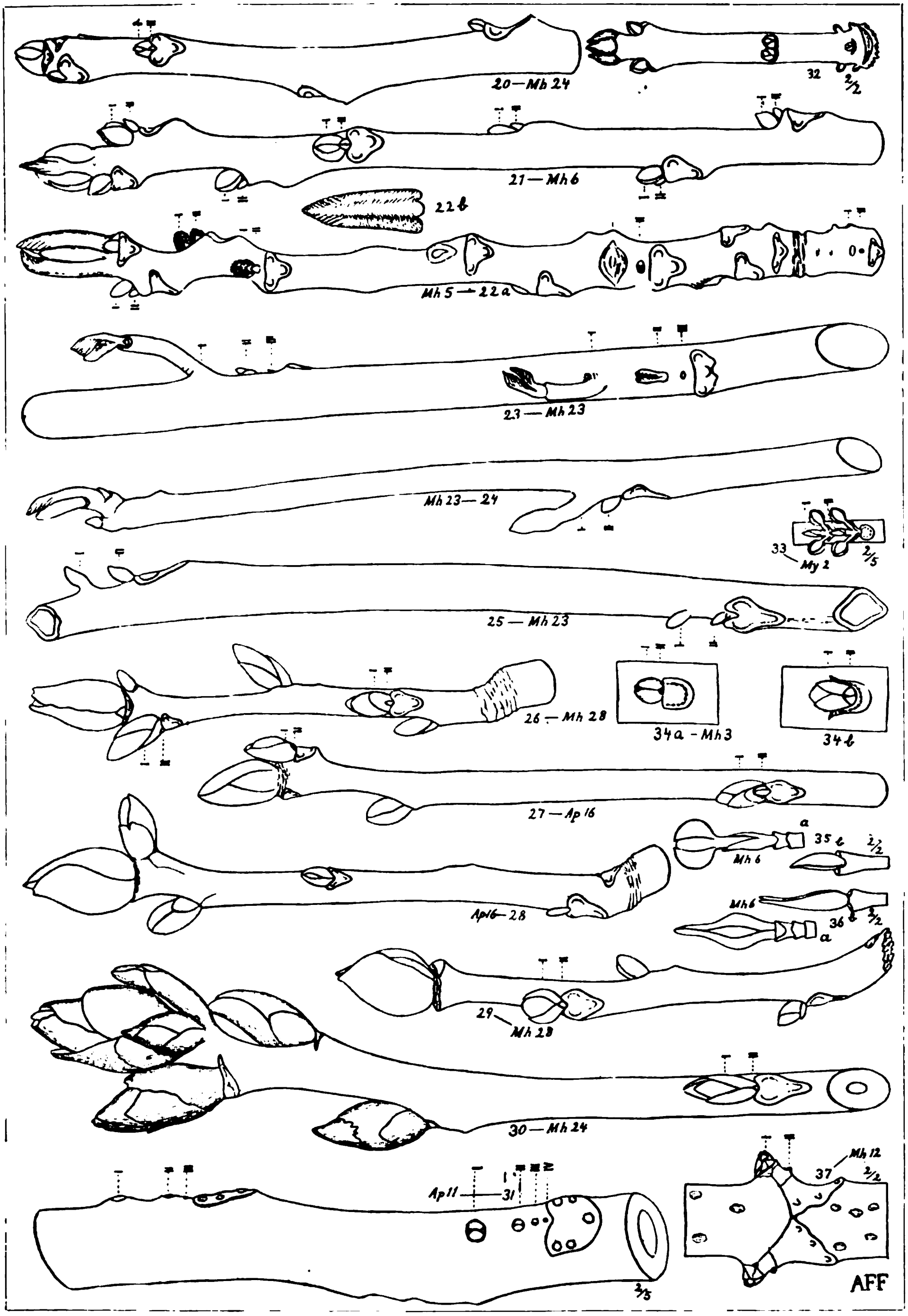
The identification of trees in winter.

AUG. F. FOERSTE.

(WITH PLATES XII AND XIII.)

Any method of identifying ligneous plants other than the ordinary one by means of their flowers and leaves, must necessarily be very artificial. Under these circumstances it is important to use as a means of comparison those parts of ligneous plants which are certain to be present both in the young growth and in the fully matured plant, and which, during the various stages of development from the small sapling to the superannuated tree, show essentially the same characteristics. There is only one part of ligneous plants which approximately fulfills these conditions and that is the crop of little twigs added each year to the tips or the sides of the branches, with the petiole-scars from the last season's leaves and the subtended, more or less scaly, winter buds which enclose a portion or all of the growth of the coming season in rudimentary form.

As a matter of fact the length of these twigs varies considerably at different stages in the history of the same individual and even on different branches of the same tree or shrub during the same season; moreover the form and size of the petiole-scars and the scaly buds vary quite commonly on approaching the tips or the base of even the same twig. If, however, the length of a twig be left out of consideration, and only the larger petiole scars and scaly buds be made objects of comparison, the constancy of color and markings of the bark, of the character of the pith, of the form and structure of the petiole-scars, of the figures presented by the foliar fibrovascular bundles, and of the form and structure of the scaly buds, is very striking. This constancy of characteristics within the limits of the same species is supplemented by sufficient *variation* in the features presented by *different* species, to make it possible to use these characteristics in recognizing the genus of ligneous plants and, in the great majority of cases, also the species. The various characteristics presented by ligneous plants will be discussed in the order of the importance, thus providing at the same time a plan in accordance with which ligneous plants can be classified artificially so as to facilitate their identification.



FOERSTE on TREES in WINTER.

I. The determination of the phyllotaxy of the leaves of the species examined, as shown by the petiole-scars remaining from last year's leaves, is the first step towards identification. It so happens that a classification of shrubs and trees into those with alternate, spiral, and opposite or whorled leaves gives rise to three fairly equal sets. The determination of the phyllotaxy of a plant at once excludes quite a large list of shrubs and trees with another kind of arrangement of leaves from the list of possibilities. The rarer phyllotaxies such as $\frac{1}{3}$ (*Spiræa opulifolia* Linn., fig. 13); $\frac{3}{8}$ (*Diospyros Virginiana* Linn.) and $\frac{3}{8}$ (*Catalpa speciosa* Warder) will of course make the identification of a ligneous plant still more easy. In certain species the phyllotaxy is occasionally or even quite regularly (*Castanea*) more or less variable in different twigs of the same tree, but these cases are sufficiently rare not to give any serious difficulty.

II. The form of the more fully developed petiole-scars and the mode of disposition of the fibrovascular bundles where intersected at the petiole-scar is the second important means of classifying ligneous plants. The following are some of the most important types:

1. In those petiole-scars where the outline is markedly rounded, the fibrovascular bundles are often arranged in a sort of circle within the scar (*Morus rubra* Linn., fig. 5; *Ampelopsis quinquefolia* Michx., fig. 6; *Celastrus scandens* Linn., fig. 8; *Rhus aromatica* Ait., fig. 16; and *Catalpa speciosa* Warder). Sometimes these bundles take the form rather of a circular area than of a circle.

2. In those petiole-scars which have a broadly circular form below but a square outline above, the fibrovascular bundles are often arranged in the form of a semicircle (*Euonymus atropurpureus* Jacq., fig. 19; species of *Fraxinus*).

3. In certain petiole-scars which are strongly horseshoe shaped the bundles form a series having approximately the same shape (*Ptelea trifoliata* Linn., *Rhus glabra* Linn., fig. 15; as variations of the last type, in species of *Fraxinus*). In the preceding three types the fibrovascular bundles are arranged in an approximately continuous series. In many other cases they form several distinct sets in the same scar.

4. Thus in certain scars, usually more or less heart shaped, these bundles form lunate sets, either in considerable number

(*Ailanthus glandulosus* Desf.) or only with three in each scar (species of *Juglans*, *Pterocarya*, *Carya*, figs. 20–30.

5. In other scars of heart-shaped form, and in the great majority of those which are lunate, the fibrovascular bundles form small circular areas. These show a sufficient constancy in their number within the same scar if only the more fully developed scars be examined and if quite a number of twigs be drawn into consideration, so that a division into scars with only three sets (*Ulmus fulva*, Michx.; fig. 3; *Celtis occidentalis* Linn., fig. 4; *Viburnum molle*, fig. 10; *Nyssa multiflora* Wang., fig. 11; *Spiraea opulifolia* Linn., fig. 13; *Hamamelis Virginica* Linn.), and into scars having five rounded sets of fibrovascular bundles is possible (*Asimina triloba* Dunal., fig. 1; *Rhus Toxicodendron* Linn., fig. 7; species of *Æsculus*). Sometimes these sets, normally five, are reduced to three in all the smaller scars, or on the weaker twigs. In other species the number usually five is occasionally raised to seven (*Sambucus Canadensis* Linn., fig. 37). The two outer sets are often more or less approximated while the median fifth set is left more isolated (*Gymnocladus Canadensis* Lam., fig. 31; *Acer saccharinum* Wang.). How far this character remains constant and therefore of value for present purposes has not been determined.

In species with opposite leaves it is also frequently of assistance to notice if the edges of the petiole scars are sufficiently extended laterally almost or quite to meet (*Cornus florida* Linn., fig. 35; *Cornus paniculata* L'Her., fig. 36.; *Negundo aceroides*, Moench, fig, 18; *Acer saccharinum* Wang.) or if they remain considerably separated from each other (species of *Fraxinus*, *Euonymus atropurpureus* Jacq., fig. 19; species of *Æsculus*.)

III. A third means for further classifying ligneous plants is the character of their winter buds.

1. These may be so situated, either concealed in the substance of the petiole scar itself, or covered by the anterior end of the scar, that the development of these buds towards spring requires the splitting of the scar, or at least a very marked forcing back of the anterior end of the same (*Menispermum Canadense* Linn., fig. 12; *Robinia Pseudacacia* Linn., *Rhus aromatica* Ait., fig. 16.

2. At times the buds are sunk into the bark of the twigs,

but are not covered by the petiole-scars, the flattened tops of the buds scarcely rising above the level of the scar or of the bark of the twig (*Gymnocladus Canadensis* Lam., fig. 31; *Ptelea trifoliata* Linn.). The flattened buds of *Ailanthus glandulosus* Desf. would probably form a closely related class. The remaining more prominently developed scaly buds can be most conveniently classified into:

3. Those which show only one or two scales exteriorly, with perhaps a glimpse of a third or fourth scale but no more (*Smilax hispida* Muhl., fig. 9; *Liriodendron Tulipifera* Linn., fig. 14; *Rhus glabra* Linn., fig. 15; *Diospyros Virginiana* Linn.; *Cornus florida* Linn., fig. 35; *Cornus paniculata* L'Her., fig. 36; *Asimina triloba* Dunal, fig. 1; *Tilia Americana* Linn.; *Lindera Benzoin* Meissner, fig. 33); and

4. Those with typically four or more scales exposed exteriorly. This class can be further subdivided into, *a*, those in which the terminal buds are typically much larger than the lateral buds (*Asimina triloba* Dunal, fig. 21; *Sassafras officinale* Nees; species of *Fraxinus*; *Juglans*, figs. 21, 22; *Carya*, figs. 26–30; *Negundo aceroides* Moench, fig. 18); and, *b*, those in which such a difference if noticeable is not typically of a marked character. In the terminal buds of the first division the exterior scales not uncommonly give more or less evidence of their origin as transformations of leaves. In the cases in which, on dissecting the scaly bud, the scales, with the exception often of the first two, are seen to be evidently metamorphosed stipules (*Liriodendron Tulipifera* Linn., fig. 14; *Fagus ferruginea* Ait.; species of *Quercus*, *Castanea*, *Carpinus*, *Corylus*, and *Tilia*) the list of possibilities is still further reduced. The marked crowding together of buds towards the tips of the branches, as in species of *Quercus*, is often evident enough to be quite characteristic of certain species, but does not serve well as a basis for more general classification.

IV. The manner in which branches are terminated gives a fourth means of distinguishing ligneous plants.

1. Thus the green tips of the newly developing twigs are in certain species cast off each spring, and in the winter-twigs the absence of the terminal bud and the presence of a scar there where the bud ought to be, can always be readily recognized (*Tilia Americana* Linn.; *Catalpa speciosa* Warder;

Ailanthus glandulosus; *Ulmus fulva* Michx., fig. 3). While in many species all, or almost all, of the tips of the branches are thus affected, in others (species of *Æsculus*) only one half the tips of the branches are thus terminated, while the remainder show the usual terminal scaly buds.

2. In other species the tip of the branches shrivels up at a very early date, before summer, but is not cast off, the shriveled tip remaining through the winter (*Diospyros Virginiana* Linn.; species of lilac).

3. Again in other cases the tiny tips are not killed in early spring, but quite a considerable portion of the more developed branch is killed back by the frosts of autumn.

4. Lastly, in the great majority of species, terminal scaly buds are always present.

V. A fifth means of determining ligneous plants is often given by the presence or absence of stipules, as indicated by the scars which remain after they have fallen off. Since these stipules usually fall off early in spring they frequently leave but indistinct scars in witness of their former presence, but a little practice will make the observer quite adept in recognizing even the poorer stipule-scars on the winter twigs. The stipule-scars, when present, may more or less encircle the stem, (*Liriodendron Tulipifera* Linn., fig. 14, or may be considerably separated, as usual (*Tilia Americana* Linn.; *Fagus ferruginea* Ait., fig. 17; *Morus rubra* Linn., fig. 5; *Hamamelis Virginica* Linn.) In certain species the stipules are represented by thorns, as in *Robinia Pseudacacia* Linn., and *Xanthoxylum Americanum* Mill. When these stipular thorns are aborted, as occurs at times in the latter species, the fibrovascular bundles destined to provide them with sap can be detected at the surface of the wood on removing the bark. Most ligneous plants never have stipules.

VI. The presence of thorns in general often provides a sixth means of distinguishing plants. Thorns representing stipules have already been mentioned. They often also represent small axillary branches, usually supplemented by normal leaf buds at their base. The relative position and character of the thorns and leaf-buds is then at times a means of distinguishing species. Thus, in *Gleditschia triacanthos* Linn., the thorn represents the upper of a series of superposed bud, and is often decidedly removed from the subtending

leaf scar; the thorn is frequently branched, and its branches subtended by distinct bracts. In *Crataegus Crus-galli* Linn., the thorn has two lateral buds, of which one exceeds the other considerably in size. The smaller bud usually perishes, the larger one develops, pushes the thorn aside, and in the older parts of the tree the thorn then assumes an apparently lateral position. In *Maclura aurantiaca* Nuttall there is usually a leaf bud on one side, and a long narrow scale with empty axil on the other.

The fact that in certain species the thorns representing branches appear only under abnormal conditions, or first in the older plants, reduces the value of thorns as constant features in distinguishing plants. Many ligneous plants also have thorns which represent only outgrowths of the bark. These are usually irregular in their disposition, but the triple spines of *Ribes Cynosbati* Linn., placed just beneath the petiole-scar is a good instance of the constancy of character and disposition sometimes shown by mere outgrowths of the bark.

VII. A seventh characteristic of ligneous plants is the presence or absence of more or less salient ridges on the bark. These show usually some more or less definite relation to the petiole scars, being frequently decurrent from the latter (*Spiræa opulifolia* Linn., fig. 13; *Cercis Canadensis* Linn. fig. 2; *Euonymus atropurpureus* Jacq., fig. 19). The more or less rounded angles of other plants are also worthy at times of observation, as in the case of the frequently eight to ten-angled stems of *Sambucus Canadensis* Linn., fig. 37.

In addition to these more important characteristics furnished by the annual growth of twigs which can be used in forming a sort of artificial classification of plants, there are others which are very useful in distinguishing the individual species.

The color of the bark of twigs usually varies in shades of brown or gray. When therefore a tree or shrub presents characteristically twigs with bark of a green color (*Negundo aceroides* Moench, fig. 18; *Sassafras officinale* Nees; *Euonymus atropurpureus* Jacq., fig. 19) or of various shades of red or purple, the color becomes a characteristic feature of value. The genus *Cornus* provides a striking instance of the success with which the color of the annual twigs can often be used in

distinguishing species. The little circular ruptures in the bark of *Sambucus Canadensis* Linn., fig. 37; and the milky juice exuding from the broken bark of *Morus rubra* Linn., fig. 5, in warmer weather are also good characteristics.

Again, the pith at times affords good features. Thus in *Diospyros Virginiana* Linn., the place of the pith is usually hollow; in *Gymnocladus Canadensis* Linn., fig. 31, the pith is reddish brown; in species of *Juglans*, fig. 20, and *Pterocarya Caucasica* Kenell, fig. 23, there is a tendency for the pith to separate into transverse plates.

The more special examination of the form of the petiole scars with their intersected fibrovascular bundles, the relative size and form of the scaly buds, the number of scales visible exteriorly, their relative size and form, are features so widely variable in different species, and yet so nearly constant in individuals of the same species, that they furnish often the best means for specific determination. The various figures presented on the accompanying plates give a very good idea of the great importance of these features for specific or at least generic determination.

The preceding discussion will suffice to give an idea of the great variety of features offered by all annual twigs of ligneous plants for the purposes of their identification. For the great majority of such plants they will suffice in determining the species, and in almost all cases there is no difficulty about the genus. Naturally there will be the least difficulty in recognizing species during winter where the flora has been best studied during spring and summer by ordinary botanical methods, and where the range of possible species is therefore very well known.

In addition to these more omnipresent characteristics there are others which are very good if present. Such are for instance the form and character of the flowering buds for next year, whether present in the shape of naked catkins or flower buds or enclosed in more or less scaly buds (*Rhus aromatica* Ait.; *Asimina triloba* Dunal, fig. 1; *Cornus florida* Linn., fig. 35; *Cornus paniculata* L'Her., fig. 36; *Lindera Benzoin* Meissner, fig. 33). The presence of flower buds within the scaly winter buds is often indicated only by the larger size of those scaly buds which contain flower buds as compared with those which contain only rudimentary leaves. It

is evidently often possible to dissect the buds and to make a careful study of the leaves and inflorescence of many species of ligneous plants and at times even of the flowers destined to blossom next year. In other words the ordinary means of botanical determination can to a certain extent be employed. As a matter of practice, however, this was rarely found necessary since the external features were found sufficient for purposes of identification.

The remains of the inflorescence of the last season is another good means of recognizing ligneous plants when this is present, as in the case of the fruited pedicels of *Diospyros Virginiana* Linn., the inflorescence of *Ptelea trifoliata* Linn., *Rhus glabra* Linn., *Ostrya Virginica* Willd., *Cornus florida* Linn. At times even the fruit remains for a large part of the winter, or is found immediately beneath the tree where it has fallen on the ground. The pods of *Hamamelis Virginica* Linn., naturally remain on the tree all winter since they do not ripen until next year.

The bark of the trees usually finds difficulty in accommodating itself to the increased circumference of the tree in its old age, so that it often provides good characteristics at that time for distinguishing species. Thus in the beech the bark remains comparatively smooth; in the sycamore it splits off in flat little pieces; in species of hickory it separates in long shaggy strips which remain more or less attached to the tree; in species of birch the bark separates into more or less thin sheets which wrap horizontally around the trunk of the tree and fall off at times. In the great majority of trees the bark cracks more or less in advanced age and the peculiar cracks thus caused form often very characteristic figures or designs—if this expression be given not too literal a sense—which can be used in recognizing the genera and at times even the species of trees. Old woodsmen use this means of identifying the older trees often with considerable success, although often mistaken in determinations of the younger intermediate trees of the same species in which the cracks are less developed.

And lastly the general habits of a ligneous plant, whether it be a vine or not, the curvature of its branches, and the like often give good characteristics, although the general aspect produced by the method of branching in a young individual and in an old tree may be very different (*Ulmus*).

Of course it must not be expected that winter twigs with their scars and buds will furnish better means of distinguishing closely related species than the ordinary botanical ones. On the contrary they are apt not to be so good. It is very astonishing, however, how successful a means of recognizing species these annual twigs can provide. Thus where species although placed in the same genus show very marked botanical differences in their inflorescence, flowers, and leaves, the characters provided by the winter buds are usually also very well marked. For this purpose the figures here given of the several species of the *Rhus* are very significant—*Rhus glabra* Linn., fig. 15, with its remains of last year's inflorescence; *Rhus aromatica* Ait., fig. 16, with its spikes for next year's blossoming; and *Rhus Toxicodendron* Linn., fig. 7. The figures given of *Cornus florida* Linn., fig. 35, and *Cornus paniculata*, L'Her., fig. 36, are also very suggestive.

On the other hand when the species are more closely related to each other there is greater difficulty in recognizing the species. And yet even then it will be seen that in proportion as the species are found to be more closely related to each other according to ordinary methods of botanical determination, they will also show greater resemblance in the characters presented by the annual twigs. The various species of walnut and hickory show this fact very well as can be seen from the accompanying figs. 20—30, which represent most of the known species. Of course in the case of the willow, where the species are distinguished often by slight characteristics, many of the species can be identified in winter only by the expert, by means of slight characteristics often beyond the power of accurate description. Any one however who will take a glance at the accompanying plates, which present with the exception of a few *Juglandaceæ* only the commoner species from the vicinity of Dayton, Ohio, arbitrarily selected for illustration, will be struck by the facility with which the various species can be recognized. Moreover it will also be seen that even the ordinary observer without botanical training can soon learn to distinguish the various species of his district during winter if he have drawings of typical annual twigs of the various species as a means of comparison.

There are in many states botanical institutions founded for

the purpose of giving practical assistance to people of that state on questions relating to botany, especially questions of practical utility. It certainly seems as though a ready means of distinguishing the ligneous plants of their states would not be the most unwelcome contribution which these institutions could make to the people if the writer can judge from the interest usually awakened among farmers and woodsmen on showing them the various means of readily recognizing the species in winter.

It is therefore believed that the preparation of a set of plates with typical figures of the annual twigs, their scars and buds, of the ligneous plants of different states, would at present be a desideratum, especially if accompanied by critical notes indicating the range of variations within the limits of the same species, and a statement of those characteristics which are most significant in the identification of each species.[1]

In any case the above notes may serve to indicate what features have been found serviceable in the identification of ligneous plants in the winter months during ten years experience and what are their relative importance. Possibly it may also lead some to take an interest in the winter condition of plants who have hitherto confined most of their botanical work to the spring and summer.

Hotel des Thermes, Paris.

EXPLANATION OF PLATES.

The superposed buds are numbered in the order of their appearance and development by Roman numerals. In *Liriodendron*, fig. 14, *s* indicates the point of juncture of the leaf proper with the sheath formed by the stipules. On the exterior sheaths the leaf itself is represented only by a scar. In *Fagus*, fig. 17, *l* indicates the hairy leaf found after the exterior scales have been removed. The two scales on either side are the stipules for this leaf. The figures, except fig. 32, were all prepared in 1883. The date at which they were collected is indicated in each case in abbreviated form. The phyllotaxy is also given, in the form of a fraction. These figures have been chosen because from the large amount of material at hand, *these* have been found to be the most typical also for subsequent years.

Plate XII.— 1. Asimina triloba Dunal. *c*. Flower bud. 2. Cercis Canadensis L. 3. Ulmus fulva Michx. *b*, bud subtended by two leaf scars, the latter representing but one leaf in the phyllotaxy; see fig. 32. 4. Celtis occidentalis L. 5. Morus rubra L. 6. Ampelopsis quinquefolia Michx. 7. Rhus Toxicodendron L. Notice how readily this species is distinguished from the last in the winter. 8. Celastrus scandens L. 9. Smilax hispida Muhl. *b*, the bud in the

[1] Just such a work as is here suggested has been in preparation for a number of years by one of our ablest botanists. We have recently inspected the drawings which are nearly completed, and the work will be ready for publication within a few years at most.—EDS.

leaf axil seen from above. *c*, a section of the bud to show the ½ phyllotaxy. 10. Viburnum molle Mx. 11. Nyssa multiflora Wang. 12. Menispermum Canadense L. 13. Spiræa opulifolia L. 14. Liriodendron Tulipifera L. *b*, one of the inner stipular sheaths of the winter bud showing a young leaf attached. 15. Rhus glabra L. 16. Rhus aromatica Ait. 17. Fagus ferruginea Ait. *b*, a bud with several scales removed. 18. Negundo aceroides Mœnch. 19. Euonymus atropurpureus Jacq.

Plate XIII.—20. Juglans regia L. Scales of terminal bud less leafy than in other species. 21. Juglans nigra L. Buds close to the axils. 22. Juglans cinerea L. Buds usually a short distance above the axil. *b*. A scale of terminal bud. 23. Pterocarya Caucasica Kenell. Peculiar leaf scar. 24. Carya amara Nuttall. Slender buds near the axil. In Carya the figures made by the fibrovascular bundles are less distinct than in Juglans and often less distinct than here figured. 25. Carya olivaeformis Nuttall. Upper of the superposed buds often remote from the axil. 26. Carya porcina. This and the following species are forms intermediate between the two preceding species with more slender buds and the three following with more oval buds. 27. Carya microcarpa Nutt. 28. Carya tomentosa Nutt. To be distinguished from the next species by its more or less tomentose bark. A few scales have fallen off from the bud. 29. Carya alba Nutt. After a few scales have fallen off from the bud. 30. Carya sulcata Nuttall. Buds often clustered at the tip, outer scales with a close appressed pubescence; color, purplish brown, grading to greenish brown. 31. Gymnocladus Canadensis Lam. 32. Fraxinus excelsior L. From the Trocadero Gardens at Paris. Two buds in one axil. A single bud in the opposite axil, not seen. It is not a case of superposed buds, nor of one bud in the axil of the outer scale of the other, but a case of dédoublement. It is the opposite of that shown in fig. 3, *b*. 33. Lindera Benzoin Meissner. 34. Fraxinus. Species unknown, but both of them believed to belong to Fraxinus Americana. To show variation of scars, which is often great in species of this genus. 35. Cornus florida Linn. *a*, flower bud. Notice setting of buds in the tip of the stem; also in *b*, and compare with next species. 36. Cornus paniculata L'Her. *a*, flower bud. 37. Sambucus Canadensis L. The lower of the superposed buds, in a longitudinal section of the stem is seen to have its fibrovascular bundles connected at the base with those of the larger upper bud. These fibrovascular bundles of the lower bud are bent *backwards* from the above mentioned point of junction, in order to reach the smaller bud; this has not been noticed in the case of the other superposed buds examined, where the fibro-vascular bundles are all directed forward.

Two new genera of Hyphomycetes.

A. P. MORGAN.

The following genera of the Mucedineæ or white molds I have had so long and they appear so distinct that I may now venture upon their publication. The first is the only genus of the Didymosporæ in Saccardo's system possessing cylindric spores. The second by its remarkable spores represents a section Dictyosporæ, which is not represented in the Mucedineæ of Saccardo's volume.

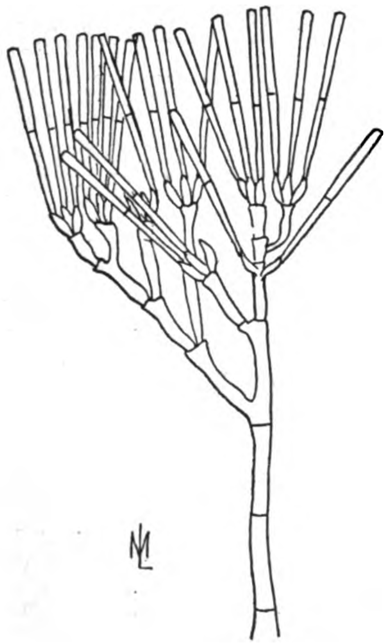


FIG. 1. *Cylindrocladium scoparium* Morgan.

Cylindrocladium gen. nov.—Sterile hyphæ creeping, branched; fertile hyphæ erect, forked or trichotomously branched, the sporophores in pairs or threes at the extremities of the branchlets and cymosely arranged; spores solitary, cylindric, 1-septate, hyaline.

C. scoparium n. sp.—Effused, thin, flocculose, white; sterile hyphæ creeping, slender, indistinct; fertile hyphæ thick, erect, hyaline, septate, cymosely branched above, the sporophores short, disposed in pairs or threes at the extremities of the branchlets, each producing a single spore at the apex; spores cylindric, tapering slightly downward, 1-septate, hyaline, obtuse at each end, 40—50μ in length, 4μ thick at the apex, and 3μ at the base.

Growing on an old pod of *Gleditschia triacanthos*. The sterile hyphæ are abundant enough, but they are fine slender

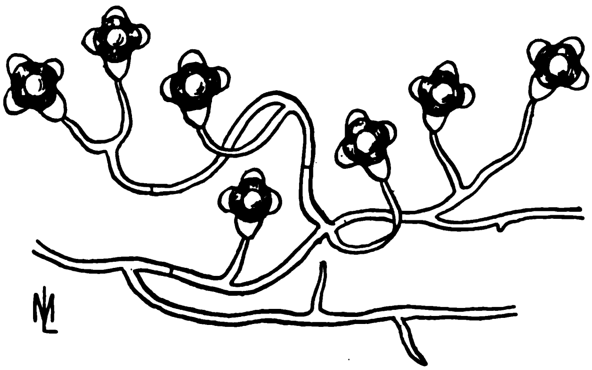


FIG. 2.—*Synthetospora electa* Morgan.

threads creeping close to or beneath the surface; the fertile hyphæ have a simple septate stem 5–7μ in thickness and are

dissolved above into a level-topped cyme of branches; their height, exclusive of the spores which easily fall off, is 125—150μ.

Synthetospora gen. nov.—Hyphæ procumbent, branched, intricate, sending out short lateral fertile branchlets, which produce the spores at the apex; spores lobed, each consisting of a large opaque central cell with several smaller hyaline cells sunk part way into its surface. The genus is a compound Mycogone.

S. electa n. sp.—Effused, thin, flocculose, white, becoming yellowish and pulverulent; hyphæ long, creeping, very slender, hyaline, scarcely septate, branched and loosely interwoven; the lateral fertile branchlets abundant, short, ascending, each terminated by a single spore; spores normally 6-lobate composed of a central globose cell, with a smaller spherical cell at the base, another at the apex, and four cells laterally on the circumference; the spores are 20—30 μ in extent, being usually a little longer from base to apex, the smaller hyaline cells measure 10—12 μ in diameter and project half way or a little more.

Growing on the hymenial surface of some *Peziza*, presumably *P. semitosta* B. & C. The habit and habitat are that of a Mycogone, but the double spore of the latter is greatly amplified. The hyphæ are quite slender, about 3 μ in thickness. The hyaline basal cell by which the spore is attached to the thread is sometimes drawn out to nearly conical; the symmetry of the spores is occasionally interfered with by the interposition of a fifth lateral cell.

Preston, O.

BRIEFER ARTICLES.

The chemical composition of the nectar of the Poinsettia.—The nectaries of *Poinsettia pulcherrima* are strongly developed and secrete so abundantly that the nectar drips away from the organs. From some specimens growing in the college green-house, a considerable quantity of the nectar was secured in very pure condition, by means of a fine pointed camels-hair pencil. It was a clear, colorless sirup, very sweet and becoming sticky on drying.

The total amount collected was 3.383 grams which, after standing some weeks over sulphuric acid, was reduced in weight to 2.3353

grams, or 69.02 per cent. of the original amount. This may be regarded as representing the solids of the nectar. It was transparent and non-crystalline. On being dissolved in water it showed a strongly reducing action toward Fehling's solution, indicating the presence of glucose sugars. In the polariscope a specific rotation of $+13.7°$ was noted, which after inversion became $-10.8°$ showing the presence of cane sugar. From the polariscope data were calculated 11.23 per cent. cane sugar and 57.7 per cent. glucose.

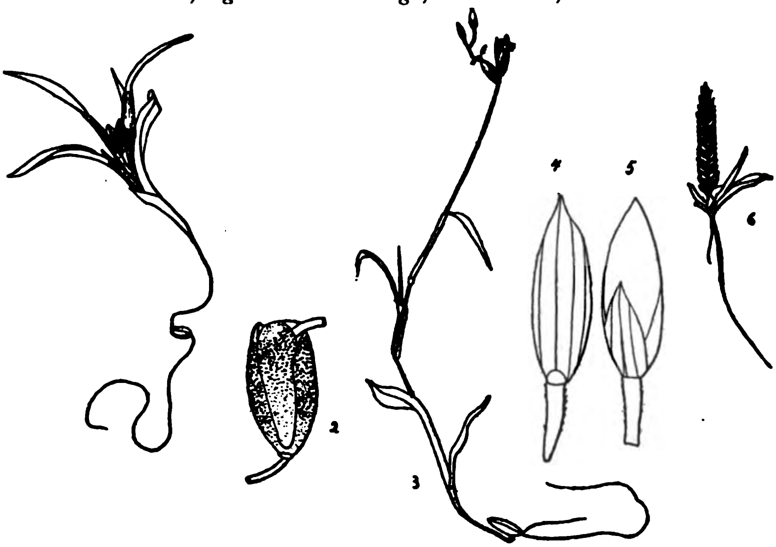
The small amount of material prevented a more extended examination. The composition is expressed very closely by these percentages: water, 30.98; cane sugar, 11.23; glucose, 57.79.

In this connection a late paper by P. C. Plugge (Archiv der Pharmacie *229*, 554) is of interest. Searching for the cause for Xenophon's reference to poisonous honey, he examined the nectar of *Rhododendron pontica* and found that it had a poisonous effect upon small animals. It was not ascertained if bees were harmed by it or not. The poisonous principle was isolated and called *andrometoxin*; it was also found in the nectar of several other Ericaceæ, the honey from which would undoubtedly be poisonous.—W. E. STONE, *Purdue University, La Fayette, Ind.*

Notes on Asclepias glaucescens and A. elata.—Dr. Palmer has just sent in from Colima, Mexico, the true *Asclepias glaucescens* HBK., which necessitates a change of name in our United States species. A. glaucescens was described and figured in Nov. Gen. et Spec. vol. III. p. 190, t. 223, from plants collected between Acapulco and La Venta de la Moxonera. Dr. Gray, in Syn. Flora vol. II. 92, refers the *A. Sullivantii* Torrey Bot. Mex. Bound. p. 162, to this species. The United States species, however, is clearly distinct from A. glaucescens and should be referred to *A. elata* Benth. Dr. Gray, however, in the Syn. Flora, Suppl. p. 401, considered the two the same species, but in the light of this new material I am convinced we have two good species although closely related. A. elata has oblong or oval leaves, rounded at the apex very like A. obtusifolia. A. glaucescens has much longer and narrower leaves, oblong to linear-oblong and acute. The flowers are much larger in A. elata and the hoods are spreading, exposing the gynostegium; in A. glaucescens the hoods are longer instead of shorter than the gynostegium and erect and connivent; there is also a good character in the horns. Dr. Gray describes the form as it is in A. elata (under A. glaucescens in Syn. Flora) where, in speaking of the hood, he says "the whole length within occupied by a broad and thin crest, which is 2-lobed at the summit, the outer lobe

broad and rounded, the inner a short, triangular, subulate, nearly included horn." In A. glaucescens the horn is a broad, triangular, incurved, entire beak.—J. N. Rose, *Department of Agriculture, Washington, D. C.*

Some depauperate grasses.—A number of small specimens of grasses were observed this spring in the propagating houses of the Horticultural Department. In many cases the seed from which the plant sprung was still attached to the root and showed no signs of decay. Three specimens were selected and drawn; *Setaria viridis* Beauv., *Panicum sanguinale* L., and *Eragrostis major* Host. These are common weeds here and are normally many-leaved and many-flowered, but having germinated in the sand they were forced for self-preservation into the production of seed much sooner than usual.—A. S. Hitchcock, *Agricultural College, Manhattan, Kans.*



Depauperate grasses: 1. Setaria viridis, natural size; 2. Spikelet attached to root of same, × 10; 3. Panicum sanguinale, natural size; 4, 5. Spikelet from inflorescence of same, × 10; 6. Eragrostis major, natural size.

CURRENT LITERATURE.

A text-book of bacteriology.

AN EXCELLENT addition to the list of hand books covering the subject of bacteriology, available to the English speaking student, has recently been published by an American firm. It is a translation of the third edition of the admirable work by Fraenkel,[1] which has already been favorably received by European teachers. The author was for a long time associated with Dr. Robert Koch, being in charge of the general laboratory of the Hygienic Institute in Berlin. The translation has been well performed by Dr. J. H. Linsley, and the publishers have put the work into an attractive and seviceable form.

The larger part of the work is devoted to laboratory methods and to the discussion of specific forms of bacteria. After a brief chapter regarding the biology of bacteria, the methods of manipulation, separation and cultivation of bacteria are treated in a particularly clear and serviceable way through nearly one hundred pages. A chapter of considerable length is devoted to the relation of bacteria to animal diseases, including the questions of susceptibility and immunity. The remainder of the book, except a few pages upon the investigation of air, soil and water, and upon yeast and molds, is devoted to specific kinds of bacteria, largely pathogenic.

The work is clearly written, with few or no digressions, and with the needs of the student, particularly the medical student, kept constantly in view. Everything that would divert the attention of the learner is omitted, and so there is no discussion of disputed points, and no citation of literature. Another omission, for which a good excuse is not apparent, is the total absence of illustrations. This sometimes necessitates rather long and uncertain descriptions of apparatus, of which a much clearer idea could be obtained from a cut.

The work is specially designed to meet the needs of the medical student, and it is not surprising, therefore, to find that the author does not take up the general treatment of the bacteria from the botanical or purely scientific point of view. Yet it would scarcely have seemed out of place to have given some hints regarding the usefulness of bacteria in the processes of nature and certainly one could reasonably hope to find some reference to their role in producing diseases of plants. But within the limitations set by the author, the work is most admirably written, and will prove a serviceable book for the laboratory and class room.

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[1] FRAENKEL, CARL.—Text-book of bacteriology; third edition. Trans. by J. H. Linsley. pp. 376. roy. 8vo. New York, Wm. Wood & Co.: 1891.

The pyrenomycetous fungi.

ONE OF THE most valuable systematic works upon fungi, yet published in this country, has just appeared. It is a thick octavo volume, with descriptions of the species (about 2,500) of North American Pyrenomycetes, including the Perisporiaceæ and Hysteriaceæ, illustrated with forty-one carefully drawn plates. Messrs. Ellis and Everhart,[1] who are also the publishers, have performed the task of gathering, studying and arranging the species of this large order in a manner that must meet the general approval of botanists. The work is more than a compilation, although even that would have been a decided service in the present scattered state of our literature, for the authors have revised the descriptions where needed, added uniform spore and ascus measurements, and looked after the synonymy. The Perisporiaceæ were elaborated for the volume by Prof. T. J. Burrill. The plates were drawn by the late F. W. Anderson, and are very satisfactory.

The methods adopted in the citation of authority for names is of particular interest at the present time. "The name of the author first publishing any species has been retained, placed in parenthesis in case the species has been removed from the genus in which it was first placed. The name after the parenthesis has been omitted as too cumbersome and unnecessary." The name, however, may be easily supplied by the reader, if desired, as it appears in the synonymy which immediately follows. The authors add, that "the piratical practice of omitting the first name and substituting the second in its place can not be too strongly condemned." Anent which we have only to quote Paul's beatitude, "Happy is he that judgeth not himself in that which he approveth."

Probably no one could have undertaken the task of arranging the American species of this order who was so well equipped for the work, both by familiarity with the plants and abundance of material, as the present authors, and it is extremely gratifying that they have produced such a satisfactory volume. It will give a decided impetus to the observation of these fungi, which will doubtless early lead to copious additions to the present work.

The volume would have been made more convenient for ready reference, if a synoptical table of genera, divisional headlines to the pages, and an index of hosts had been provided. There is, however, an excellent species index prepared by W. C. Stevenson, Jr. The volume is substantially and neatly bound.

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[1] ELLIS J. B., and EVERHART, B. M.—The North American Pyrenomycetes: a contribution to mycologic botany. 8 vo. pp. 793. pl. 41. Vineland: Ellis and Everhart, 1892.—$8.00.

Two books on elementary botany.[1]

Miss Newell's earlier volume treating of the vegetative parts of plants was favorably commented on in this journal at the time of its appearance several years ago. The present part treating of the flower and fruit is quite up to the mark of its predecessor; and as the subject it deals with is much more difficult to handle, that is to be taken as high commendation.

The book commences with a study of the bulbous plants that are commonly raised in the house, such as the tulip, hyacinth, crocus and snowdrop. From these the student is led to the earlier spring flowers, the forest and shade trees, the later spring and early summer flowers. In the treatment of each topic there is a combination of morphology and biology with taxonomy, which will strike most people as judicious, while the more radical will say that the taxonomy would better have been left for later study. The author is evidently escaping from the shackles of the older organography, as the mixture of the older and the more modern ideas and expressions indicates. To cite a single instance: On page 19 we are told that "Anthers are generally two-celled." On page 59: "Anthers are generally two-lobed, or as they are called, rather incorrectly, two-celled"; and in a footnote the real structure of the anther is explained. Errors are unusually rare and this alone is a strong commendation when so many of the elementary books seem to be written by persons who do not know whereof they speak. The plants themselves and the difficulties young pupils are most likely to encounter are evidently intimately known to the author. We do not know a book which is better adapted for its purpose than this one, and can most heartily recommend it to those whom its title addresses: "teachers, and mothers studying with their children." The illustrations are from the pen of Miss H. P. Symmes, and although there is something of technique to the desired in their execution, they exhibit much artistic feeling and essential accuracy.

The other book is of wholly different sort, not only in the way in which the subject is treated, but also in its quality. Miss Aitken has essayed to produce an "elementary text book of botany for the use of schools."[2] It is divided into three parts, the first being designated "Outlines of the external morphology and classification of flowering plants"; the second, "Description of some typical non-flowering plants

[1] Newell, Jane H.—Outlines of lessons in botany for the use of teachers, or mothers studying with their children. Part II: Flower and fruit. 12mo. pp. vi. 393. Ginn & Co., Boston: 1892.

[2] Aitken, Edith.—Elementary text-book of botany for the use of schools. 12mo. pp. xiii. 248. figs. 131. Longmans, Green & Co. London: 1891.

or cryptogams; the third, "General description of flowering plants." Under the first part is given a very brief organography, which is not at all accurate, followed by descriptions of single members of the more important orders, from which pupils are supposed to derive a "typical example" for the purpose of "grouping exceptional forms around the central type, to which in memory one should always return." We very much doubt the wisdom of such a plan, and its execution leaves much to be desired.

In the two succeeding parts the author is endeavoring to follow the pattern of Huxley and Martin's Biology. As it seems to us, however, she has neglected the most essential feature of their plan, viz.: the preparation of specific directions for the "practical work" of the student. The headings of this sort in this book do not cover any directions that will be of use to the student. The "practical work" follows a description of the plant. Under Funaria for instance, one reads, "Examine specimens of Funaria, and verify the facts mentioned above." Here are others: "Cut sections of the stem and observe the different kinds of cells." "In older specimens examine the sporogonia." It is quite certain also that many of the directions, particularly in physiological parts, have not been put to the test; else their impracticability would have been discovered. The figures, except those from other works, are poorly drawn for photo-engraving and consequently very blotchy. Altogether, so far as American schools are concerned, Miss Aitken has contributed nothing of educational value.

Minor Notices.

In a recent number of *Education* Professor Conway MacMillan has a vigorous criticism of the current methods of botanical instruction. Mr. MacMillan is radical and has at command an expressive vocabulary. The paper is worthy the attention of every teacher who can correct his own work thereby or who can influence others to do so. We should like to quote more than this sentence had we space: "The whole course in 'botany' is so planned that at its close the pupil may practice a few diagnoses, may apply a few binomial names and may gather a collection of pressed flowers which are pasted carefully in a synopsis book—such as certain misguided persons have been unable to refrain from publishing—and the whole unfortunate affair is dignified as a herbarium and is afterwards filed away upon some garret shelf, while its owner does not scruple, when questioned, to admit that he has 'had botany.' And he does not think very highly of it either."

In the Proceedings of the Biological Society of Washington for May 18, 1892, Mr. F. V. Coville describes, in advance of the full report of the collections of the Death's Valley expedition, several new species from that interesting region.

The report of the Royal Botanic Gardens at Trinidad for 1890 has been distributed. The report shows the work of the gardens in economic and scientific lines. Much attention is being given to the encouragement of the growing of fruits and fiber plants in the island. The illustrations are Messrs. Sprague's well-known "ink-photos" which almost equal the American "half-tone." The form of the report would be much improved by a change from folio to octavo. The Superintendent, Mr. J. H. Hart, working no doubt under many difficulties, is evidently active in promoting the interests of the garden.

OPEN LETTERS.

A botanical congress and nomenclature.

At a meeting of the Botanical Club of Washington, held April 23, 1892, a committee was appointed to consider and report upon the questions of botanical congress and nomenclature. At a special meeting called May 7, this committee presented the following report which was unanimously adopted by the club:

"Your committee, appointed to consider the questions of a botanical congress and botanical nomenclature, held a meeting on the second of May and prepared the following resolutions:

"*Resolved*, That, while favoring the final settlement of disputed questions by means of an international congress, we do not regard the present as an opportune time, but we recommend the reference of the question of plant nomenclature first to a representative body of American botanists.

"We suggest the consideration, by such body, of the following questions, among others: the law of priority; an initial date for genera; an initial date for species; the principle once a synonym always a synonym; what constitutes publication; the form of tribal and ordinal names; the method of citing authorities; capitalization.

"We recognize the Botanical Club of the A. A. A. S. as a representative body of American botanists and commend to that body for discussion and disposal the subject of nomenclature as set forth in these resolutions.

"Respectfully submitted,

Lester F. Ward, Geo. Vasey, F. H. Knowlton, B. T. Galloway, Erwin F. Smith, Geo. B. Sudworth, Frederick V. Coville. *Committee.*"

It was voted that a copy of these resolutions be communicated to the Botanical Gazette, *Torrey Botanical Club*, *Garden and Forest* and *Science*.—L. H. Dewey, Sec'y, *Washington, D. C.*

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1 Berichte der deutschen botanischen Gesellschaft: x. 27.

NOTES AND NEWS.

M. Casimir Roumeguere, editor of the *Revue Mycologique* died recently at his home in Toulouse.

The director of the botanical gardens of Palermo, A. Todaro, died on the 18th of April last. His successor is Dr. Hermann Ross.

Dr. Eduard Regel, director of the Imperial Botanical Garden at St. Petersburg died on the 27th of April, at the age of 77. He has been director of the St. Petersburg garden for nearly 40 years.

The claims of *Ulota Ameriacna* to autonomy are discussed by Dr. G. Venturi in a recent number of the Revue Bryologique, where he also considers several forms of American Orthotricha collected by Röll and others in the northwest.

The summer classes in botany at Martha's Vineyard, under the instruction of Mr. Edward S. Burgess, will be held this year as usual, meeting from July 11 to August 12. Courses in structural and systematic botany and in histological botany will be offered.

Dr. A. Zahlbruckner has examined the changes proposed in certain genera of lichens by Kunze in his already notorious Revisio Generum Plantarum. Two of the names proposed are accepted; two are to be replaced by others of earlier date; and two, in spite of their priority, cannot be accepted, as they do not coincide with the modern genera.

Mr. M. C. Cooke announces a handbook of Australian fungi of 500 octavo pages and thirty-six partly colored plates. It is published under the authority of the several governments of the Australian colonies, and only eighty copies are reserved for sale in Europe and America. The price is thirty shillings (about $7.50). It may be ordered from the author.

The third annual banquet in memory of Henry Shaw was given by the trustees of the Missouri Botanical Garden at the Mercantile club in St. Louis on May 19. About eighty-five guests, of whom fifteen were from other places, sat down to tables most beautifully decorated with orchids, cut flowers, potted plants and smilax. After an elaborate and elegant dinner, addresses were made by Dr. J. D. Butler, of Madison, Wis., Revs. Stimson and Snyder, of St. Louis, and D. C. Hart Merriam, of Washington. Chancellor Chaplin, of Washington University, presided.

A series of 15 lectures and field meetings will be held at the Arnold Arboretum during May and June for the purpose of supplying popular instruction about the trees and shrubs which grow in New England. They began on Saturday, May 7th, and will close June 25th. They will be conducted by Mr. J. G. Jack. After a review of the plants to be especially observed during the meeting the class will adjourn to the plantations and the nurseries of the Arboretum for an informal study of the plants themselves. An hour and a half to two hours will be devoted to each meeting. An autumn course of fifteen meetings will be given from September 7th to October 26th. This course will give an opportunity for studying many of the trees and shrubs in fruit, their autumn foliage, and their buds and general appearance as they prepare for winter.

// BOTANICAL GAZETTE

JULY, 1892.

On the genus Lindbladia.

GEO. A. REX.

The genus Lindbladia of the Myxomycetes, is represented by a single species only. This species, *Lindbladia effusa* (Ehr.) Rost., has a wide range in the United States, having been found in one or the other of its forms in several of the middle and western states. The genus and species have been described by Rostafinski as follows:

LINDBLADIA Fr.—Æthalium naked, composed of numerous irregularly polygonal, minute sporangia with the walls grown together; surface to the extremities of the sporangia warted. —Rtfki. Mon. 223.

LINDBLADIA EFFUSA (Ehr.) Rostfki.—Æthalium naked, seated on a common, strongly developed hypothallus; cortex when prematurely dessiccated black, thick, brown, lustrous, with the surface rough; mass of spores brown-ocher or umber; spores bright colored, smooth .0058–.0072 mm. diam.—Rtfki. Mon. 223. Cooke, Myxomycetes of Great Britain.

Unfortunately the brief diagnostic description of Rostafinski as given above, and also in the *Sylloge Fungorum* of Saccardo, only covers in reality a comparatively small portion of the forms which are legitimately included within the limits of the species. The explanatory notes, however, which accompany this diagnosis in the *Monografia Sluzowce*, give a supplementary description of the more complex æthalioid forms, to which belong a large portion of the American specimens of Lindbladia, and also such European specimens as I have had the opportunity of examining.

An analysis of all American specimens will show a surprisingly varied series of forms, all of which may be properly classed under the one species. Although these are different in their external appearance, they possess the same morphological details.

In addition to the true æthalioid forms described by Rostafinski and others, a form with simple sometimes substipitate sporangia is found in all sections of the northern United States, which, for many reasons, is worthy of varietal distinction. It may be described as follows:

Var. **simplex** var. nov.—Sporangia simple, gregarious, either free and separate or crowded and touching each other but with the walls not grown together; standing in effused clusters on a common hypothallus; elongated ellipsoidal in shape or distorted by crowding; usually either sessile with a narrow base, or substipitate attached to the hypothallus by a black plasmodic point of attachment, or occasionally stipitate with well marked short brown-black rugose stipes; entire sporangia averaging one mm. in height. Sporangium walls simple, sometimes lustrous, often having a few longitudinal folds in their lower half, pale umber colored, roughened externally by being thickly studded with rounded dark-brown plasmodic granules; spores in mass pale umber colored, from 5.5—7.5μ in diameter, with thin epispores very delicately warted but apparently smooth under lenses of medium power.—*Perichæna cæspitosa.* Pk.; no. 2,700 N. Am. Fungi, E. & E.

Common in the northern and western states. Stipitate form found in Shawangunk Mts., N. Y.

The occurence of stipes in this variety of the species, which has hitherto been described as æthalioid only in character, is a point of great interest.

Undoubtedly, the extreme forms of the species are apparently very diverse, there being a great range between the simple variety above described and the thick effused æthalia often found, although the area of hypothallus covered by the sporangia is as great in one case as in the other.

The morphological characters common to all these forms, however, are so positive that it is not possible to separate even the extremes by a valid specific distinction.

The æthalia vary greatly in thickness and structure, and may have either a naked or corticate surface. The simplest form of æthalium is composed of irregular or polygonal sporangia, standing in a single rank on a common hypothallus, with the lateral walls grown together, the upper surface being roughened with the dark brown plasmodic granules. These simple æthalia grade into other and more complex forms of æthalia, which grow in effused or sometimes hemispherical

patches often three quarters of an inch thick, and in the first case many square inches in diameter. They are formed of entangled or interwoven masses of elongated or branched sporangia with the walls grown together.

Some of these æthalia have the upper surface irregular and naked, formed simply of the convex apices of the component sporangia. Others have a nearly plane upper surface composed of a thick cortex, developed from and upon the apices and external portions of the sporangia. The special character of the æthalia, whether naked or corticate, seems to be determined by environment or by conditions affecting the plasmodium during its differentiation into sporangia. It is not in any degree dependent upon the size of the mature æthalium, for I have seen both of these forms of the maximum thickness attained by the species.

The spores of all forms, simple and æthalioid, are identical, being delicately warted under high power lenses. The hypothallus of all forms and the cortex of the corticate æthalia are composed of thick plasmodic membranes containing irregular particles of plasmodic refuse.

The hypothallus has an irregular laminated structure, composed of a varying number of thin membranous layers. In the simple variety it is a nearly uniform membrane being at most composed of but two or three layers. In the æthalia however the layers are numerous, not closely touching each other at all points, but separated at intervals, leaving sometimes quite large and wide interspaces which give the hypothalli a loose open structure. In the hemispherical æthalia it may form a sponge-like expansion of one-quarter to one-half an inch in thickness, upon which the branched and interwoven sporangia are erected.

The plasmodic colored granules which are found in the sporangium walls of all specimens of Lindbladia, are exceedingly interesting when examined under a high power lens, and are worthy of careful study. The exterior walls of both the simple variety and the naked æthalia, are thickly studded with these granules which are deeply colored with a violet-brown pigment. They are irregularly spheroidal in shape, averaging about 1.15 μ in diameter. They are composed of a plasmodic investing membrane continuous with the wall of the sporangium, which encloses a rounded nuclear mass also plasmodic in structure, but of a different density and refractive quality.

They project outwardly from the sporangium wall and are attached to its outer surface so slightly as to be readily broken off, leaving a ring-like base, thus giving the membrane of the wall the appearance of being covered with minute elevated annular markings or sculpturings.

Plasmodic granules similar in structure, but flattened and unpigmented, having been modified by their conditions, are found imbedded in the septa or dividing walls between the component sporangia of all the æthalioid forms, corticate as well as naked.

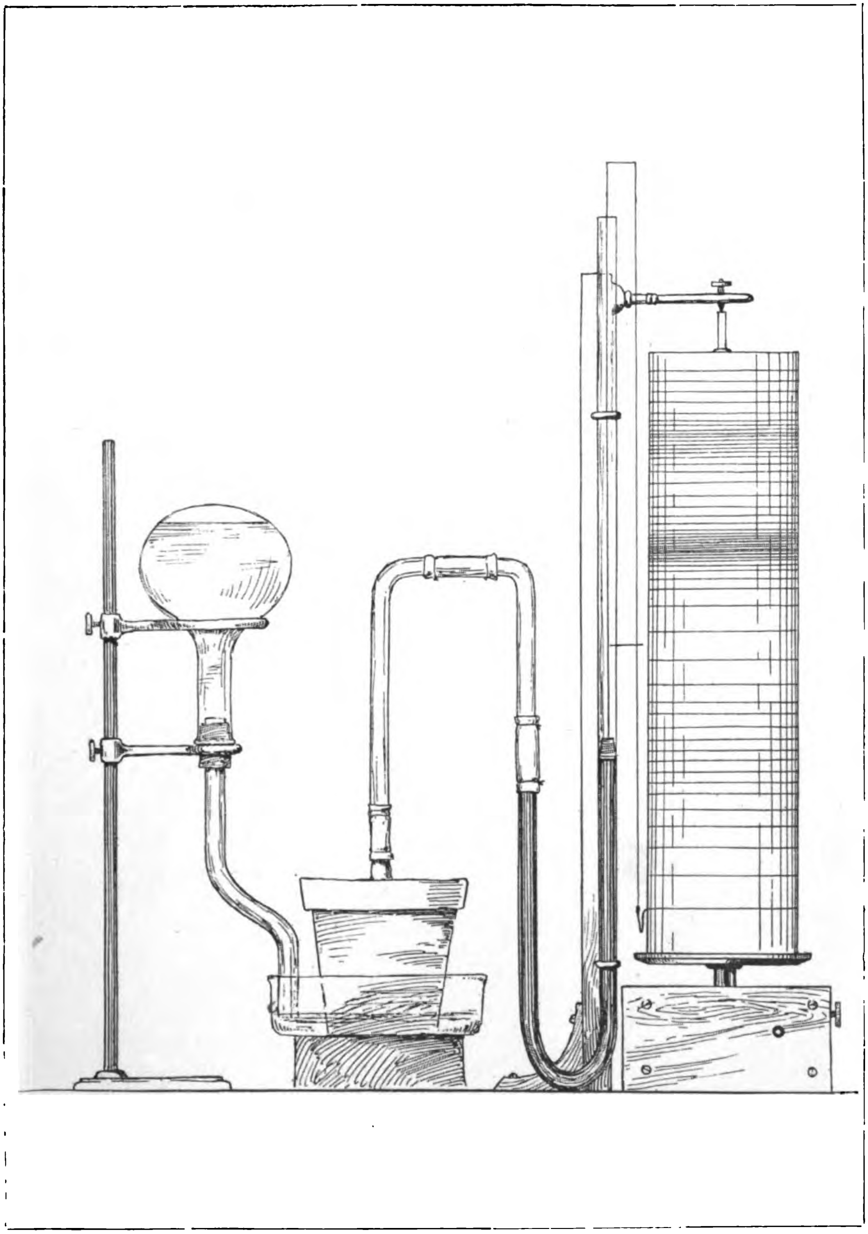
The various reagents which may be used in the preparation of the sporangium wall for microscopic examination, as for instance, alcohol and acidulated water, or the glycerine media used for permanent slide-mounts, will also develop the same annular markings, by softening and disintegrating the thin investing pellicle of the granules, thus freeing the denser nuclei which are comparatively unaffected by the reagents. This fact suggests the possibility of error in conclusions drawn from examinations made from mounted material only.

The natural relations of closely allied genera to each other will always prove an interesting and profitable subject for study, and the relations of Lindbladia and Tubulina, both genera belonging to the same order, LICEACEÆ, will serve as a striking illustration of this point.

The genus *Tubulina* shows an analogous and nearly parallel course of development to Lindbladia, in a series of forms also beginning with simple, separate, aggregated sporangia on a common hypothallus, and extending through various similar æthalioid forms; always however having the sporangia in a single rank, and finally even developing in some instances a partial cortex. At one point of the parallel development of the two series, the analogy is so great that the corresponding forms, if considered by themselves, would be properly classed as species of the same genus, the generic characters being so similar.

Yet Lindbladia, especially through its simple variety, more nearly resembles in some important structural characters the order HETERODERMEÆ through its genus *Cribraria*, than it does the analogous genus Tubulina of its own order.

These special points of correspondence are first, the existence of plasmodic colored granules throughout the whole



THOMAS on ROOT-PRESSURE.

genus Cribraria (in common with the rest of the Heterodermeæ), similar in construction to those of Lindbladia except that they are permanent and not evanescent under the conditions above detailed; second, the similarity of the sporangia of at least one species, *Cribraria argillacea*, with its practically permanent wall, to those of the stipitate and substipitate forms of Lindbladia effusa var. simplex.

It is, therefore, a legitimate inference, that Lindbladia and Tubulina, although they closely approach each other, having been similarly developed along parallel ordinal and partially parallel generic lines, probably arose from independent and perhaps widely separated points of origin.

Philadelphia, Penn.

The tendrils of Passiflora caerulea.

D. T. MAC DOUGAL.

(WITH PLATE XIV.)

I. Morphology and anatomy.

The work recorded in this first paper was undertaken for the purpose of determining the factors in the movements of the tendrils of the Passifloræ, more particularly the movements by which a tendril responds to a stimulus, resumes its original position, or on continuance of the irritation coils permanently, and its subsequent changes while coiled and serving as a support for the weight of the adjacent part of the plant body.

Accepting as entirely tenable the view that the other movements of the tendril are the results of conditions of growth and varying states of turgescence, they will be considered only in so far as they affect the coiling of the organ. With this end in view, attention will be directed to the arrangement of the tissue systems, their relative mechanical value as determined by the structure of the individual cells composing them, the continuity of the protoplasm between cells of similar and dissimilar tissues with reference to the irritability and power of conducting impulse of the parts concerned, and to the physiological changes induced in the motile cells by the stimuli to which this organ responds.

The first investigations on the nature of tendrils of which we have any record are those of Palm[1] and Mohl[2] published within a few weeks ot each other in 1827.

The descriptions in these works are necessarily very meager; the one dealing with the subject from a physiological standpoint while the other reasons from the structural characters alone.

In 1858 Prof. Asa Gray published his paper on the movements of the tendrils of the cucurbitaceous plants [3] which led Darwin to undertake a series of observations which he finally extended to more than one hundred species, the results of which were published in the Journal of the Linnean Society 1865. [4]

Hugo de Vries in his "Zur Mechanik der Bewegung von Schlingplanzen"[5] deals chiefly with the difference of growth of the upper and lower sides of tendrils and the mechanism of movement of twining plants. All of these workers were concerned chiefly with the outward phenomena of movement rather than morphological changes and structural condition. Contemporaneous with these observers and later, much notable work has been done on the organogeny, structure and physiology of tendrils.[6]

To determine the conditions prevailing in the tendril during its period of sensitiveness it was thought necessary to study

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[1]PALM: Ueber das Winden der Ranken. [2]MOHL: Ueber das Winden der Ranken und Schlingpflanzen.

[3]Proc. Amer. Acad. of Science and Arts.

[4]Climbing plants.

[5]Arbeiten des botanischen Institut in Würzburg, 1873, Band I. Heft 3.

[6]BRAVAIS BROTHERS: Annales Sc. Nat. 2 Sér., 1837.—ST. HILAIRE: Leçons de Bot. p. 170. 1841.—DUTROCHET: Comptes rendus. tom. 17. p. 989, Des mouvements revolutifs spontanes, 1843.—SACHS: Lehrbuch der Botanik; Physiology of Plants. —WYDLER: Flora 1853, Pringsheim's Jahrb. 1878, tome 2, page 317.—FRITZ MUELLER: Journal of the Linnean Society, vol. 9.—DE CANDOLLE: Bulletin de la Soc. Bot. de France, 1857.—LEON: *ibid* tom. 5, p. 680, 1858; Gardeners Chronicle 1864, 721, quoted from Darwin.—MCNAB: Trans. Bot. Soc. Edinburgh, vol. 2, page 292.—LOTAR: Essai sur l'anatomie comparée des Cucurbitacèes, Lille, 1871.—SCHWENDENER: Das mechanische Princip im anatomischen Bau der Monocotylen, 1874.—EICHLER: Blüthendiagramme, 2 vol. 1879.—DUTAILLY: Assoc. franc. pour l'Avanc. des Sc., 8 session: Recherches sur les Cucurb. et les Passiflores, 1879.—HABERLANDT: Physiologische Pflanzenanatomie.—VINES: Physiology of plants, 1886; La Sensibilitie et la motilitie.—MORREN: Des Veg. Bruxelles 1885 p. 52.—OTTO MUELLER: Untersuchung über die Ranken der Cucurbitaceen, 1886, in Cohn's Beitræge zur Biol. der Pflanzen.—PENHALLOW: Mechanism of movement of Cucurbita, Vitis, and Robinia. Proc. Roy. Soc. Canada, vol. 4, sec. 4, 1886.—PFEFFER: Zur Kenntniss der Kontaktreize; Untersuchungen aus dem bot. Inst. zu Tübingen, Band I, 1885.—RUSSELL: Recherches sur la Vrille des Passiflores: Bulletin de la Soc. Bot. de France, 189, 1890.—MASTERS: Trans. Linnean Soc., 1878, p. 317.

its development through all stages of growth from the time of its appearance as an axillary papilla till it passed out of the sensitive stage. During the latter periods of growth sections could easily be made with the aid of pith and a common hand clamp and the collodion embedding method,[7] while in the younger stages a modification of the paraffin methods given by Moll, Campbell and Andrews in the BOTANICAL GAZETTE[8] was found to be more satisfactory.

The greatest difficulty, however, was experienced in fixing and hardening the material. The whole organ is in a state of extreme tension and the contact of any reagent on the sensitive concave surface will, unless it has sufficient strength and penetrative power to kill and fix the protoplasmic body instantly, cause the tendril to roll up in a helix, and the form of the wall and contents of the motile cells would be much distorted. A wide range of reagents was tried with but partial success in any case. Alcohol in strengths varying from 1 per cent. to 96 per cent. was found to be useless, as also corrosive sublimate. Potassium nitrate was found to give the best results in a 4 per cent. solution, but caused the organ to form an open helix. Chromic acid distorted the protoplastic structure besides rendering the sections difficult to stain. Schulze's chrom-acetic-osmic solution was useful only in tendrils less than 2 mm. in length. A mixture of one part distilled water and one part saturated solution of bichromate of potassium retained the structures fairly well in many cases, as did also weaker solutions of the same.

By far the best results were obtained by the use of acetic alcohol of the following composition: 1 part glacial acetic acid; 6 parts absolute (or 96 per cent.) alcohol; 3 parts chloroform.[9]

The tendril must be carefully cut from the stem with the least possible jarring and avoiding all contact with the sensitive lower surface, and then placed in the fixative which must be in a vessel of sufficient dimensions to receive its entire length in a horizontal position. The action of the fluid will cause it at first to curve slightly, and then to regain its former position. After two or three oscillations of this sort it will regain and keep nearly its original form. After remaining in this fluid for a time varying from 20 to 30 minutes, it was re-

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[7] Proc. Am. Soc. of Microscopists, 1890. THOMAS: Botanical Gazette, Nov. 1890.

[8] January and June, 1888; July, 1890.

[9] LEE: Microtomists Vademecum, 1890.

moved, cut into convenient lengths and placed in 96 per cent. alcohol which was changed several times to remove the acid.

Sections were made with a Cambridge rocking microtome, fastened to the slide in series and after the removal of the paraffin stained in a hæmatoxylin-eosin mixture of the following composition: distilled water, 5 parts; hæmatoxylin (Delafield's) 3 parts; eosin (watery solution) 2 parts. The sections were allowed to remain in the staining fluid 20 minutes. After dehydrating and clearing they were mounted in Canada balsam dissolved in oil of cajeput. The differentiation afforded by this stain can hardly be excelled. The nuclear structures take a dark purple color while the remainder of the cell contents and the walls take on various shades of red according to density.

The tendrils of Passiflora cærulea are filamentous organs springing from the axils of the leaves, often reaching a length of 30 cm., tapering from a diameter of 2 mm. at the base to 1 mm. at the tip before coiling. When 1–3 cm. in length the whole surface often has a reddish purple tinge due to color bodies in the subepidermal cells. With growth the color becomes less vivid and is distributed over the surface in ill defined longitudinal bands. It often disappears entirely from the lower surface, being hidden by the deeper tinge of the chlorophyll.

The tendril makes its appearance as a cone of meristem tissue on the side of the growing point in the axil of a leaf. Shortly after its appearance while it is yet less than .5 mm. in length, there is formed on its summit an irregular cup-shaped depression (fig. 4) by reason of the excessive growth in length of the periblem, that of the upper side being greater. The continuance of this unequal growth causes the cup in the full-grown tendril to become lateral (fig. 5). About the time the cup has assumed the form in fig. 4, spiral vessels make their appearance just below it, followed by companion and sieve cells. The point of most rapid growth passes backward with the elongation of these fibrovascular elements until at the time of coiling it is found at a short distance below the middle of the organ.

When the tendril has reached this stage three distinct regions may be distinguished: the base or non coiling part, 3–4 cm. in length; the middle region or coiling portion comprising the greater part of the organ, which is generally slightly curved; and the sharply curved or hooked tip, 4–6

mm. in length. These three regions show some well marked differences in structure and outline. The whole organ shows a bilateral organization which is least apparent in the base and most pronounced in the portion having the greatest power of movement, a recognized correlation given by Dr. Otto Müller.[10]

The basal portion is broadly oval in outline with just a trace of flattening on the lower side; the middle portion is oval with its lateral much greater than the transverse diameter, while the lower surface is distinctly flattened. The tip is nearly circular in outline, and bears at its extreme end the cup-shaped formation above mentioned. Along the convex upper and lateral sides of the tendril are several obscure angles which are mostly absent from the lower concave surface.

The internal structure of these parts shows corresponding differences. The arrangement in the middle portion is as follows: The epidermis consists of a layer of rectangular cells with the longest diameter parallel to the long axis of the tendril (figs. 1, 2, 3, *a*). Occasional stomata are found distributed equally over both surfaces.[11]

Beneath the epidermis is a layer of collenchyma with thickenings so disposed that that the tangential are much heavier than the radial walls (figs. 1, 2, 3, *b*). Scattered through this tissue are the color bodies mentioned above. At the obtuse angles of the tendril this layer is three cells in thickness, at other places it decreases to one.

Internal to this is a layer of loosely arranged thin walled parenchyma of varying size, containing in the outer rows of cells an abundance of chlorophyll and protoplasm (figs. 1, 2, 3, *c*). The inner rows of cells bordering on the bast are richly loaded with starch, constituting the starch layer of Sachs.[12]

Through the entire layer are occasional crystals of calcium oxalate. The cells of this layer on the convex side are uniformly larger than those on the concave side, leading to a corresponding difference in thickness of the layer. The in-

[10] "Soweit also die Ranke central gebaut ist, zeigt sie kein Krummungsvermögen: soweit sie bilateral gebaut ist, soweit betheiligt sie an den Einkrummungen." l. c., p. 120.

[11] Pfeffer: Zur Kenntnis der Kontaktreize, Par. 9.

[12] Physiology of Plants, p. 358; Strasburger: Das botanische Practicum, p. 132.

tercellular spaces are large and plentiful by reason of the peculiar manner of junction of conical ended cells. In many cases, however, the entire ends of adjacent cells are pressed closely together, presenting the phenomenon (seen in figs. 2 and 3, *c.*) of one cell sending a protrusion into the cavity of another. It is evident that these cells by both structure and arrangement are well fitted to undergo great variations in size, while the large intercellular spaces, affording plentiful space for the reception of expelled cell sap, make possible rapid changes in the tension of this tissue. The parenchyma is connected with the central pith by medullary rays, two to four cells in height, in the region of secondary growth.

Immediately internal to the starch sheath is the bast region consisting of thin walled, closely packed cells, containing a large amount of dense protoplasm. These are in a condition of rapid growth which gradually becomes less active as the tendril approaches maturity, when they take on excessive wall thickenings, in a manner very similar to that of Cucurbita (fig. 1, *d.*).[13] When the tendril has only reached a fraction of its length this tissue has formed a continuous band interrupted only by the medullary rays.

About the time of maturity the cambium makes its appearance and soon forms a ring of secondary growth on the inner side of the bast, and retains its activity even after the coiling. The primary xylem elements (fig. 1, *e*) are about ten in number; half are disposed in a nearly straight row across the concave side, while the remainder are in an approximate semicircle to conform to the outline of the convex side. Each bundle consists of two or three spiral vessels arranged radially (with generally an annular vessel placed axially), which show marked lignification even in the immature organ. The formation of secondary bundles takes place in such manner on the concave side that a continuous band of wood is formed here, while the xylem elements of the other side retain their individual character until after coiling. The central pith is composed of large parenchyma cells containing some protoplasm.

The basal portion differs from this in its regular oval outline, symmetrical arrangement of the xylem, heavier thickening of the collenchyma, and early formation of a continuous distinct cambium zone. Lignification has extended slightly

[13] PENHALLOW: Proc. Roy. Soc. Canada, vol. 4, sec. 4, 1886, p. 54.

to the pith, and parenchyma in the xylem, which has three or four spiral vessels besides an annular vessel in each bundle. The central pith is generally found torn apart forming the lysigenetic intercellular spaces of De Bary.[14]

The structure of the tip, however, is widely different from that of either of the regions just described. Near the extremity of the concave side may be seen the oval aperture of the cup formation lying transversely to the length of the tendril, appearing white because of the absence of chlorophyll in the tissues beneath. The cavity is .3–.4 mm. across in a direction parallel to the long axis of the tendril and about .8 mm. in a transverse measurement, with a depth of .5 mm. (fig. 6, *e*). The epidermal cells of this region become smaller toward the extremity and are smallest on the floor of the cavity (fig. 6, *a*, *a'*). The collenchyma is composed of one row of shortened, strongly thickened cells terminating at the rim of the cup (fig. 6, *b*, *b'*).

The chlorophyll layer undergoes no changes on the concave side except a slight reduction in size and an increased density of the protoplasm, a feature common to the region except certain cells near the cup. The parenchyma layer of the convex side is relatively very thick, and is composed of very angular, much distorted cells, many of which have their long diameters perpendicular to the surface as seen in fig. 6, *c*.

The bast and cambium decrease in size and disappear entirely shortly after they enter this region. The scattered bundles of xylem of the convex side and the band of the concave side converge as they near the cup and are separated only by a thin spindle of pith. The termination of the tracheary tissue is marked by a mass of epithema,[15] composed of long, slender cells with oblique ends, appearing as a continuation the tracheæ, and touching directly the epidermal layer of the cup without the intervention of the collenchyma layer.

All the tissues of the tendril are abundantly supplied with pits, especially the parenchyma of the pith and cortex, which have numerous simple pits, oval in form, arranged transversely, with the torus present. The inner side and radial walls of the parenchyma of both the concave and convex surfaces communicate with the adjacent cells by similar structures; those of

[14] Comparative Anatomy of Phanerogams and Ferns, Eng. Ed., p. 200.

[15] De Bary: Comp. Anat. of Phanerogams and Ferns, Eng. Ed., pages 375–376.

the collenchyma being most numerous on the tangential walls. The markings of fibrovascular elements are of the common form in this type of plants. The arrangement of the protoplasmic body of the organ with reference to density and composition, bears a direct relation to the sensitiveness of any part of the organ. The protoplasm is most dense and richly granular in the epidermis and chlorophyllous cells of the concave surface near the tip. The density decreases as it passes back into the middle region where it is quite uniform throughout. The contents of the epidermal cells and collenchyma of this side take the stain most deeply as does the epidermis of the convex side, which, as well as the underlying tissue, is very similar over the entire surface.

It may be assumed in conclusion, that the concentration of the protoplasm in the epidermal layer has a direct connection with irritability, that the movements of the organs are due to changes in the chlorophyll layer and that the disposition of the xylem elements is favorable to rapid flexion and extension, and that the abundant supply of reserve food material is a provision for the rapid growth and fixation of the tendril upon coiling.

Purdue University, La Fayette, Ind.

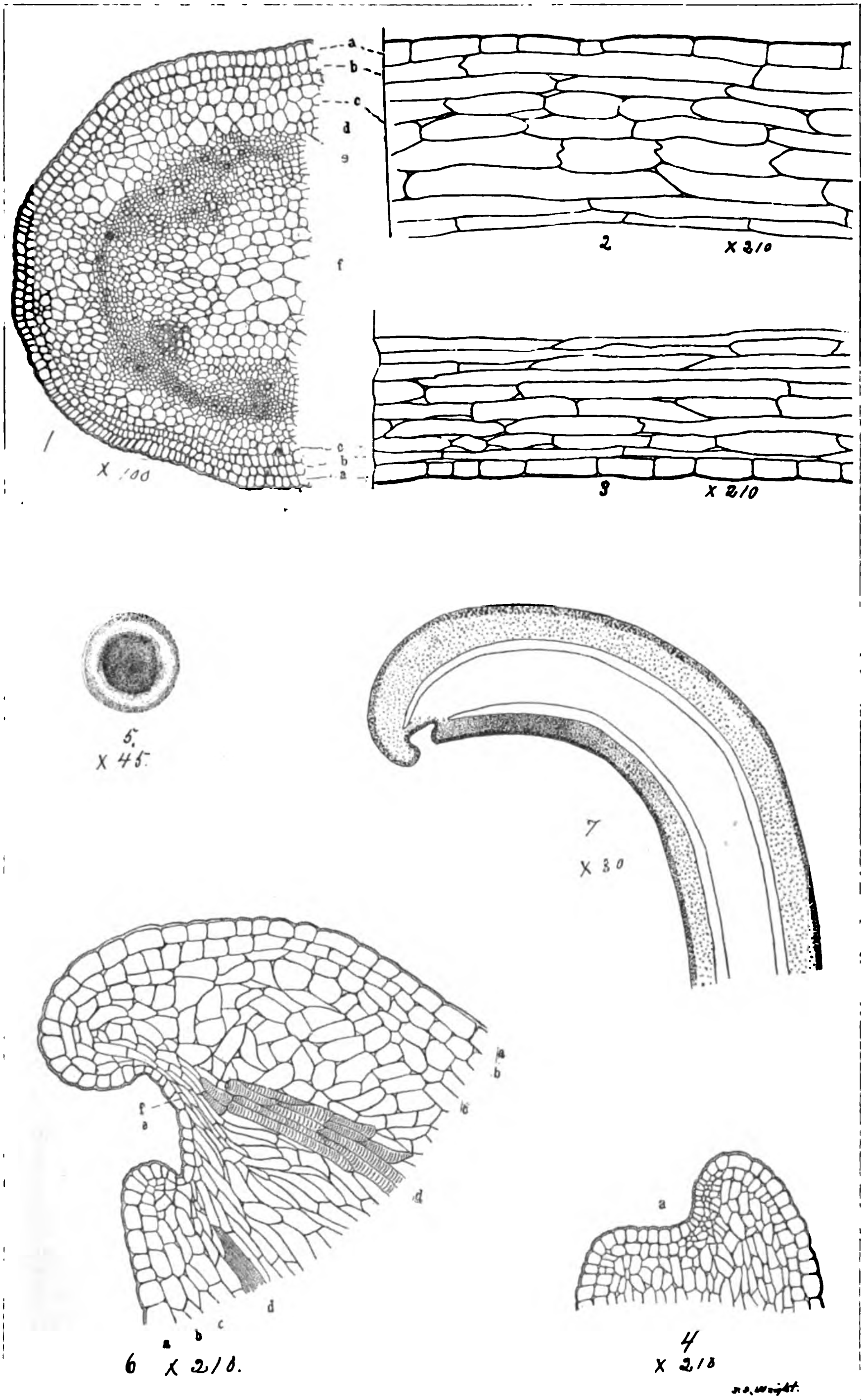
EXPLANATION OF PLATE XIV.—Fig. 1. Half cross section of middle portion of tendril.—Fig. 2. Longitudinal section of convex side of same.—Fig. 3. Longitudinal section of concave side of same. *a*, *a'*, epidermis; *b*, *b'*, collenchyma; *c*, *c'*, chlorophyll parenchyma; *d*, bast; *e*, xylem; *f*, pith.—Fig. 4. Longitudinal section of tip of tendril showing cavity, *a*.—Fig. 5. Cavity of same seen from end.—Fig. 6. Longitudinal section through tip of mature tendril. *a*—*d*, same as in fig. 1; *e*, cavity; *f*, epithema.—Fig. 7. Diagram showing distribution of protoplasm in tip and part of middle region of tendril.

An apparatus for determining the periodicity of root pressure.

M. B. THOMAS.

(WITH PLATE XV.)

The study of the periodicity of root pressure has received much attention from physiological botanists and the results of quite extended researches have been published by Sachs, Hofmeister, Detmer and others. The work has been done with very crude apparatus consisting simply of a manometer



MacDOUGAL on TENDRILS.

or a glass tube attached to the stem at its base by means of a rubber tube making with it a water-tight connection. The observations were recorded by marking upon the tube each hour to indicate the rise of water in the tube or by measuring it with a scale in the glass or on a strip of paper or wood behind it. The apparatus required frequent attention and was in no sense self-registering. The other methods used were modifications of these but in all cases frequent attention was required.

The following self-registering apparatus is suggested: The base of the apparatus is about 1 by 3 feet and is supported by legs about 3 inches high. About 10 inches from one end and in the center of the base is erected a standard about 2 feet high and 4 inches in width. On the short end of the base and near the post is fastened a set of strong clock-work (the Seth Thomas "marine works" answer the purpose very well). The clock-work is covered with a box, and the end of a cylinder 6 inches in diameter and 1 foot 10 inches high is fastened to the hour pinion by means of a pin passing through a hole in the end of the pinion and fitting in a slot in the end of the cylinder. The top of the cylinder is held in place by a pin passing through a support from the main pillar, and a hole in the end of the cylinder.

To the large upright pillar is fastened a U-tube, about ½ an inch diameter, one end being nearly as high as the pillar and the other but half the height. The tube is filled with mercury to within about an inch of the top of the short arm. The stem of the plant is cut off near the base and placed in position. An inverted U-tube is fastened to the stem in the usual way by means of a rubber tube tied with wire while the other end of the U-tube is connected to the larger one in the same way. The small U-tube is filled with water through an opening in the top.

The cylinder is made of bright tin and is blackened by revolving it slowly in the flame of a lamp or gas jet.

The indicator consists of a light steel wire with a cork at the end somewhat smaller than the diameter of the tube. This rests on the mercury. It is then at the top of the tube bent at right angles twice and allowed to extend to the bottom of the cylinder, where it is again bent at right angles and the end allowed to rest against the smoked surface of the cylinder. A pin driven in the pillar prevents the wire from turning to one side because of the friction of its end with the cylinder.

As the root absorbs water the pressure upon the column of mercury increases, causing it to rise in the tube, lifting the cork and indicator with it. The indicator then marks a continuous spiral course on the cylinder. As the cylinder revolves once each hour the hourly variation can be studied by observing the distance between the lines.

The supply of water given to the plant is kept constant by means of a flask of water supported by a stand and having an exit tube touching the surface of the water in the dish in which is placed the jar containing the plant.

The apparatus can be made in sizes appropriate for the study of periodicity of root pressure in almost any plant.

An eight day clock should be used and the apparatus need scarcely be touched until the plant is exhausted. The difference between the maximum and minimum variation will grow less as the column of mercury becomes higher but the time of variations will be the same for each day.

The apparatus described may be constructed at a very small expense and used either for laboratory experiments or lecture room demonstration. Many new and interesting problems have arisen during the investigations with this instrument and it is hoped they can be arranged for presentation in the near future.

The record on the cylinder of the apparatus shown in plate XV was made by a tomato plant. The experiment was started at 9 A. M., that being the time represented by the bottom line on the cylinder. The apparatus is represented otherwise as at the beginning of an experiment.

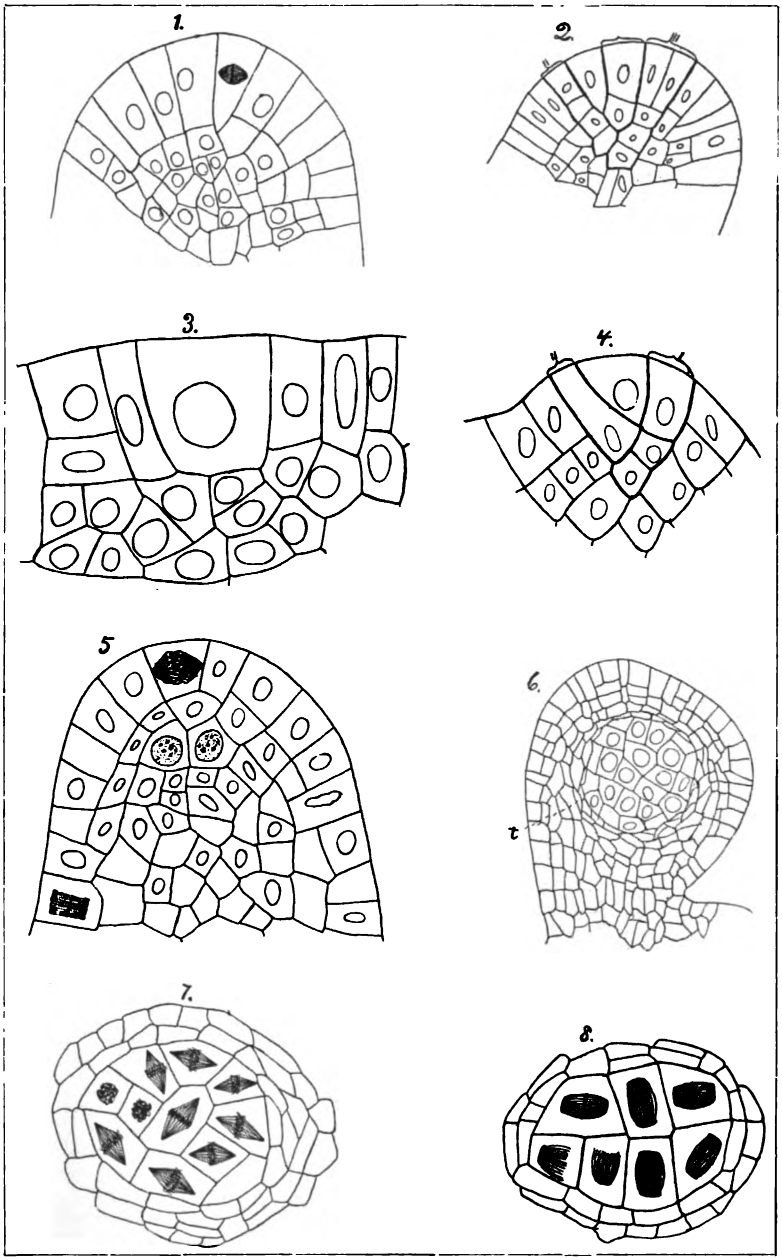
Wabash College, Crawfordsville, Ind.

On the apical growth of the stem and the development of the sporangium of Botrychium Virginianum.

C. L. HOLTZMAN.

(WITH PLATE XVI.)

The origin and affinities of the Filicineæ is one of the most important problems of systematic botany. Among investigations directed to solving this problem not least have been those concerning the origin of the Filices and the relations of the eusporangiate and leptosporangiate groups. It has been advocated by some that the Ophioglosseæ form a natural se-



HOLTZMAN on BOTRYCHIUM.

ries, running from Ophioglossum to Botrychium Virginianum; the latter being closely related to Osmunda and through it, as the connecting link, with the Filices, forming the complete phylogeny of the Filicineæ. With this in view it was thought that if the development and mode of growth of the meristems of Botrychium Virginianum were known, it would possibly show more closely its relations to Osmunda and help to clearer views concerning the position of the eusporangiate ferns.

Dr. Douglas H. Campbell in a comparative study of the roots of Osmunda and Botrychium[1] shows that the roots grow from a clearly defined apical cell in the form of a three-sided pyramid. From the general fact that a fern grows from the same shaped cell in all parts, roots, stem and leaf, it would be expected that a cell of similar form would appear in the stem of this same plant (fig. 1). It is slightly longer than that of the root, but has unmistakably the form of a three-sided pyramid. In the stem figured the nucleus also appears in a state of division. Unless growing very slowly the segments retain their distinctness for a considerable time, often the outline of as many as three or four being easily traceable (fig. 2); while the segments follow the general rules of segmentation and divide by a transverse wall slightly below the center of the cell. The lower part may then divide into several cells by transverse and longitudinal walls; and the upper part first by a longitudinal wall into two, then each of these into two or more, thus after a time confusing the limits of each segment.

Turning now to the sporangium, we find that in the Filices proper the sporangium always arises from a single epidermal cell, which usually, according to Bower[2], projects more or less strongly beyond the surrounding tissue before segmentation begins; then a transverse wall cuts off a lower cell from which the stalk develops, and from the upper one the sporangium proper, or head of the sporangium, arises.

In Botrychium this distinction cannot be made. The sporangium is first noticed as a cell of large size (fig. 3) on the side of the pinnule in section, but not protruding beyond the other cells. The nucleus in the specimen figured, from its comparatively large size and appearance, seemed ready to divide.

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[1] Notes on the apical growth of Osmunda and Botrychium, BOTANICAL GAZETTE, Feb. 1891.

[2] BOWER: The comparative examination of the meristems of ferns as a phylogenetic study; Annals of Botany, III. 362.

Three oblique walls are formed one after another, thus giving rise to a three sided apical cell. The sporangium now projects slightly (fig. 4), and in the figure probably two segments have been cut off and will be devoted to forming the stalk of the sporangium. While it is true that the sporangium arises from a group of cells, and probably some cells other than those heavily shaded (in fig. 4 those cut off from the original cell) take part in the formation of the sporangium, yet it seems equally probable that the entire sporangium can be referred to the single large cell (fig. 3). If this be true, a closer connection is shown with the leptosporangiate group than has been generally supposed. In Osmunda[3] the sporangium is not always referable to a single cell in its origin, but almost always one is noticeable as the initial cell of the young sporangium, which does not project before segmentation occurs. After the formation of the apical cell the sporangium grows to a considerable size by direct segmentation before any change is apparent. There now becomes prominent the change of the apical cell from a tetrahedral to a cubical form, from a T-division (fig. 5). Three cells, from their general shape, are evidently those which previously formed the single large tetrahedral cell. The sporangium is now probably half grown and the cell from which the archesporium and tapetum develop should make its appearance; but from the great bulk of the sporangium it would escape notice, unless it had a very large nucleus. Not until the primary cell has undergone several divisions are the archesporium cells noticeable (fig. 5). In the sporangium figured there were six of these, all very prominent from the large nuclei in them. These cells divide very rapidly, and cause the body of the sporangium to enlarge, making the distinction of body and stalk noticeable (fig. 6). The stalk is seen to be very short and thick, and the tapetum layer also makes its appearance, consisting of approximately two layers of cells. Even the oblong cell which retained the place of the initial, after the division of the tetrahedral cell, is now no longer distinguishable, each cell dividing as rapidly as possible and the whole sporangium enlarging equally in all parts. It is during the rapid division of the archesporium cells that a very interesting and previously unnoted (?) occurrence was observed, namely the simultaneous division of *all* the archesporium cells in one sporangium. In one (fig. 7) all nuclei were

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[3]L. c., p. 362.

in the so-called spindle stage of division, with probably forty to fifty cells in the sporangium. Another stage (fig. 8) showed the division nearly completed, while four or five other sporangia showed their nuclei in various other stages of division.

It appears evident that the origin of the archesporium in Botrychium is more deeply seated in the tissue than it is in the Filices. This, with other characteristics of complexity of structure, according to the generally accepted view, places the Ophioglosseæ in origin as the most recent forms, in opposition to the more primitive Filices. However, it seems probable that the Filices have been a degenerating group, becoming more and more simple according to the nature of their surroundings, and thus necessarily giving rise to new forms; while the Ophioglosseæ retained their complexity and suffered no change, giving them thus the position of the more primitive forms. This we see is supported by Bower[4] with geological evidence.

The material used was fixed in one per cent. chromic acid, stained in aqueous alum-carmine, and after dehydrating, passing through turpentine and imbedding in paraffin, was sectioned on a Minot microtome; then stained on the slide with seventy per cent. alcoholic bismarck-brown to sharply differentiate the cell walls.

Indiana University, Bloomington.

EXPLANATION OF PLATE XVI.—Fig. 1. Young stem of Botrychium Virginianum showing the apical cell dividing; four segments shown. $\times$ 225.—Fig. 2. Pinnule; apical growth; outlines of three segments shaded. $\times$ 225.—Fig. 3. Portion of longitudinal section of pinnule showing origin of sporangium (large cell) $\times$ 450. —Fig. 4. Sporangium after apical cell is formed, two segments having been cut off. $\times$ 325.—Fig. 5. Sporangium in an advanced state of growth, two of the six archesporium cells shown; also the disappearance of the tetrahedral apical cell by a T-division. $\times$ 325.—Fig. 6. Sporangium nearly full grown; *t*, tapetal layer. $\times$ 170.—Figs. 7 and 8. Archesporium cells dividing, tapetal layer of two layers of cells surrounding them. $\times$ 325.

[4] BOWER: Is the eusporangiate or the leptosporangiate the more primitive type in the ferns? Annals of Botany, vol. V. no. XVIII.

Noteworthy systematic and distributional researches.

Recent work in systematic hepaticology.

For a long series of years the systematic study of Hepaticæ seemed to be held in abeyance to the settlement of various morphological problems, and the earlier activity of Nees von Esenbeck, Gottsche, Lindenberg, De Notaris and Sande-Lacoste on the systematic side came to a close midway in the fifties and was revived only by a few descriptive papers by Mitten in the sixties. Starting with the period of Hofmeister and Grönland in the fifties the study of the morphology and development of the group culminated after the preliminary investigations of Kny, Kienitz-Gerloff and Leitgeb in the masterpiece of the latter in 1881.[1] Commencing in the seventies and coming down to the present, some of the best descriptive work among the Hepaticæ has been accomplished largely by representatives of four European countries: Spruce, Pearson and Mitten of England, Lindberg (now deceased) of Finland, Massalongo and De Notaris of Italy and Stephani in Germany. The last decade especially has been prolific in new forms and the recorded number[2] of Hepatics in Synopsis Hepaticarum (1844) has been nearly doubled.

Spruce, whose masterpiece on the Hepaticæ of the Amazon and Andes, is well known, has described recently[3] thirty-four American species mostly from South America, three only being from Mexico. Jack and Stephani have described 18 new species from Peru and the United States of Columbia. Stephani has described two Hepaticæ from North America which were collected by Dr. Julius Röll, besides the Lejeuneas described in the June GAZETTE.

Asiatic Hepaticæ have been described by Lindberg and Arnell,[6] who enumerate all the known species of Asiatic Russia (96) three of which are new; and by Mitten[7] who enumerates

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[1] LEITGEB: Untersuchungen über die Lebermoose, 4to, Graz, 1874-81.

[2] 1641 species: Luerssen in his *Handbuch der systematischen Botanik* (1879), curiously estimates the known species at 1300. The number will prove to be not far from 3000.

[3] Hepaticæ Novæ Americanæ tropicæ et aliæ. Bull. de la Soc. Bot. de France, XXXVI, pp. cxxxix—ccvi.

[4] Hepaticæ Wallisianæ. Hedwigia, XXXI, 11-27 (1892).

[5] Bot. Centralb. XLV, 203—4 (1891): Marchantia Oregonensis (Oregon) and Porella Roellii (Washington).

[6] Musci Asiæ Borealis, Kongl. Svenska Vet.-Akad. Handl. XXIII, no. 5, (1889).

[7] On the species of Musci and Hepaticæ recorded from Japan. Trans. Linn. Soc., Botany, III, part 3, (1891).

all the known species of Japan (74) of which thirteen are new; he also describes two Chinese Frullanias.

From Africa numerous contributions have been made to our yet scanty knowledge of the hepatic flora of the Dark Continent largely through German exploring parties. Dr. F. Stephani of Leipzig has described these, his latest papers[8] including 31 new species. Renauld and Cardot[9] publish a list of 190 species of Hepaticæ from Bourbon, Mauritius and Madagascar; a number of new species are mentioned but not described. Pearson[10] describes three new Frullanias from Madagascar.

From Australia a considerable number of species have been described in recent years by Stephani, and Carrington and Pearson, but the greatest number of novelties has been described from New Zealand by Colenso in a series of papers in the Transactions of the New Zealand Institute.

The species of the Sandwich Islands have been brought together by one of our own countrymen, Mr. A. W. Evans of New Haven[11]; 117 species are included in this list, of which five are new. Several of Austin's MS. species are also described. In addition to the species of this list 22 species were described from these islands by Mitten in Flora Vitiensis and *Anthoceros Hawaiensis* by Reichardt in 1877, thus bringing the list up to 140 species which number will be doubtless increased when some modern collecting is undertaken there.

In all the above descriptive papers, the diagnoses are full and are strongly in contrast with many of the two-line descriptions of some cryptogamic writers who have caused untold trouble by their brevity and inaccuracy. Many of the species, especially those in the larger genera, are figured.

Besides the above systematic papers we have an "Arrangement of the Genera of Hepaticae", by Mr. Evans,[12] which is highly creditable and will prove very useful. His estimates for the number of species are cautious and usually low. *Bazzania*, for instance, is credited with 100–125 species while

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[8] Hepaticæ Africanæ. Hedwigia, XXX, 201—217, 265—272 (1891). Earlier papers with same title have been published by Stephani in Engler's Bot. Jahrbücher (1886), Hedwigia (1888), and BOTANICAL GAZETTE (1890).

[9] Revue Bryologique, XVIII, 55—60 (1891).

[10] Frullaniæ Madagascarenses. Christiania Vid.-Sel. Forhandl. 1890, no. 2 (1891).

[11] A Provisional List of the Hepaticæ of the Sandwich Islands. Trans. Conn. Acad. VIII, [pp. 1—9] (1892).

[12] Trans. Conn. Acad. VIII [pp. 20] 1892.

Stephani in 1886 gives a list of 169 which even then was not quite complete. The species of *Metzgeria* have doubled since Lindberg wrote his monograph which is quoted as giving eleven species. We note the absence of three of Mitten's genera, *Conoscyphus*, *Mastigopelma* and *Plectocolea*. *Cronisia* Berkeley, which Lindberg changed to *Carringtonia* because he did not believe in anagrams,[13] is also omitted from the series. So also are some of Trevisan's innovations,[14] but possibly the less said of these the better. The widely scattered literature has rendered this work by Mr. Evans specially difficult. [15] A number of generic names will have to be replaced on grounds of priority whenever we have a sufficiently stable system on which to make the shift. One hundred and seventeen genera are included, of which 87 belong to the Jungermaniaceæ. And yet the text-books persist in regarding Marchantia as a representative liverwort!—LUCIEN M. UNDERWOOD.

The psammophilous flora of Denmark.

Prof. Warming presents a sketch of the peculiar vegetation of the dunes and sandy plains in Denmark,[16] arranged according to their occurrence in the following zones: (I) "The psammophilous *Halophyta*" from the sandy strand; (II) "the vegetation characterized especially by the grass *Psamma*" from the dunes along the coast; and (III) "the *Weingærtneria*-vegetation," where this grass prevails, and which has been observed on the sandy banks along the coast or in the interior of the country.

In the first of these "formations" the characteristic is the *Halophyta*, which live here on a loose, sandy and salt-bearing soil, the surface of which is very dry and warm during certain seasons. This vegetation does not form any dense growth, since the consistency of the soil is very variable. The plants belong to two categories; annuals or perennial herbs mostly with widely creeping rhizomes, while trees and shrubs are almost absent. Among the annuals are Cakile, Salsola,

[13] Cronisia was based on *Corsinia* which it resembled.

[14] VITTORE TREVISAN: Schema di una nuova classificatione delle epatiche. Mem. R. Ist. Lomb. di Scienze e Lettere, ser. III, IV, (1877).

[15] There is needed a classified bibliography of the Hepaticae and on this we have been working for several years and hope to reach publication of the first part (author catalogue) in a few months.

[16] EUG. WARMING: De psammophile Formationer i Danmark. Videnskap. Meddel. Naturh. For. Kjöbenhavn 1891.

species of Atriplex, Senecio viscosus, Salicornia and the variety salina of Matricaria inodora. The perennials are represented by Alsine peploides, Triticum junceum, Festuca rubra, Lathyrus maritimus and the very rare Carex incurva and Petasites spuria. Only a few perennial herbs without creeping rhizomes are recorded from this locality, such as Crambe, Eryngium and Mertensia, all of the species "maritima."

What the author has called the "Psamma-formation," the second zone, includes the vegetation of the dunes which are most typically developed along the coast, where they give the landscape its very singular appearance. They are barren hills exposed to raging storms, and with a vegetation always very poor and monotonous. The plants must be able to resist a living burial in the moving sands. But as a matter of fact the formation of these dunes is actually due to their growth. *Psamma*, *Elymus* and *Triticum* make the foundation, holding the sand together by means of their roots and rhizomes; gradually a hill forms by the continuous deposits of shifting sand. When these plants have succeeded in forming the dune, others soon follow, represented by Weingaertneria, Calluna, or, in some cases, by Hippophaë, and the former growth of Psamma gradually dies out.

It is stated that a single tuft of Psamma has caused the formation of a dune about twenty meters high. This plant is, therefore, better fitted for resisting sand burial than any other. It not only does not hurt it to be covered entirely by the sand; its growth seems really stimulated, the ascending shoots stretching themselves so as to reach the surface and the sunlight.

Elymus arenarius is also a valuable plant for making stable the sand, although it is not nearly so important as Psamma, and does not seem to thrive well before the sand has been fixed. A few other grasses might be mentioned as belonging to this vegetation, namely, Festuca arenaria and some species of Triticum. The spiny, silvery-grayish shrub, Hippophaë rhamnoides, thrives here, and forms almost impenetrable thickets, due especially to its rapid propagation by root-shoots. The roots have been observed to reach a length of about five meters and to go down in the ground to a depth of about thirty cm., developing dense tufts of shoots.

The third zone is characterized by *Weingaertneria* along

with several other plants, which first occupy the soil, prepared by the "Psamma-vegetation," and which, to some extent, contribute to the stability of the sand; for instance, Sedum acre, Taraxacum, Sonchus, Leontodon, Carex arenaria, Thymus, etc. Some of them propagate by root-shoots, while others have widely creeping rhizomes, e. g., *Carex arenaria*, or runners above ground. Weingaertneria differs from these by its cespitose growth which is due to a profuse development of shoots from the axils of the lowest leaves. The young flowers are well protected by the large leaf-sheaths, as is also the case with Psamma.

There are besides these types a few others, which propagate by a multicipital root; such plants are very common in the fixed sand, and several species are enumerated.

These perennial plants have meanwhile prepared the soil for another growth which consists of annuals and biennials; but the immigration of these depends upon two conditions: the sand must have become entirely stable, and its vegetation must not be too dense.

The dune has now gradually changed its character as to soil and vegetation, and it is not seldom that it finally becomes a heath, producing a growth of Calluna and Empetrum.

Among the peculiarities of these sand plants the author enumerates and describes several singular anatomical features. It seems as if the adaptation for regulating the transpiration were the main object, and that end is gained by diminishing the leaf-surface. Several of these plants show, therefore, narrow or very short leaves; the stomata become less numerous and often confined to deep furrows or cavities, a common feature in the Gramineæ. The leaves, or their divisions, are often raised more or less vertically; a covering of hairs or wax is very common, so as to protect the stomata; while in some others a thick cuticle is characteristic. Species of succulent plants are comparatively few in number.—THEO. HOLM.

BRIEFER ARTICLES.

Living fossils.—The great flat slab on which we stood seemed built there to command a view of stoneworts.

In the clear lime water of Fall River, S. D., floated great streamers of Chara, fresh and green, yet fading insensibly, first into a dingy, then into a dead looking, and even into a stony mass, as the eye followed it up stream. It was a streamer of living, growing stoneworts that blended into the slabs of "petrified moss" strewn broadcast in the channel around us, and on one of which we stood.

But the eye could trace this so-called living fossil or petrifaction back still further to the banks overhead, where other stoneworts once floated in waters whose channel was higher than and broader than now. Yet higher still, in an earlier channel, the eye could see great slabs of it, upturned in a railroad cutting.

At our feet, where interposing boulders had reduced the transporting power of the current, a sand bar of broken stems, leaves, and whorls was lying, simply waiting for the "lapidifying juices" to cement it into limestone—a sort of puzzling Chara breccia.

Right here in reach then were all the terms of a botanico-geological stonewort series, a sort of climax, beginning with the perishable, growing plant, and capped by the same built into everlasting rocks and sands.

It only remained for the collector to make his choice, which was done, and the series exposed in a row to dry. The growing stonewort, so fresh and green, became stony, and crumbled at a touch, it was so incrusted with lime salts. So, too, the half-living, half-petrified form fell to pieces, being encrusted just enough to appear stiff and stone-like, yet not enough to last. However, slabs of the "petrified moss" of any desired linear dimensions could be had, and handled with impunity. These ever forming stonewort slabs consisted of a few inches of rigid lithified creek bed, as a stable sort of backing to the stony mat of weeds upon them.

By placing the growing stonewort immediately in glycerine it is easily preserved, and by patience, mixed with a pinch of ingenuity, the whole beautiful and interesting series of living petrifactions can be kept.—ERWIN H. BARBOUR, *University of Nebraska, Lincoln.*

EDITORIAL.

THE COMING MEETING of the American Association for the Advancement of Science is to be one of the most important of recent years so far as botanists are concerned. For that reason, if not for the pleasure of meeting other botanists and reading and hearing interesting papers, there ought to be a large attendance of botanists. The meeting is to be held in the city of Rochester, N. Y., from Aug. 17th to 24th. Reduced rates, one and one-third fare, will be granted on the usual certificate plan on all the railroads of the Central Traffic Association. The University of Rochester opens its buildings to the sections, and the usual receptions and excursions are announced.

Of foremost interest to botanists will be the proposed division of section F into two, and the formation of section G, of botany, leaving F for zoology. This question is to be discussed and settled at this meeting. In case the section is divided, the status of the Botanical Club is to be considered.

It is probable also that the proposed botanical congress in connection with the World's Fair will come before the section for discussion. The Committee which was asked by the World's Fair Auxiliary to take steps to organize such a congress recently prepared a circular letter to the botanists of the country which they vainly tried to have issued as it was prepared. It was only after long delay that it was issued at all, and on its appearance the members of the Committee were nearly as much surprised at its contents as those to whom it is addressed must be. Although the Committee may hope for some information through this inflated circular, they will expect to ascertain more of the temper of the botanists toward this scheme at the coming A. A. A. S. meeting.

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ONE OF OUR good friends writes: "I wish that the less ponderous and profound botanists were not so 'offish' in sending contributions to the GAZETTE. I like to have the work of the editors more appreciated and not sunk out of sight by over-weighty articles. . . . The *Bulletin* makes me swear . . . . ; and the GAZETTE, alas, puts me to sleep!" We almost envy the *Bulletin* this distinction; anything but being prosy! Yet it is with a clear conscience that the editors print this accusation against the "less ponderous and profound botanists;" it does not lie against the editors.

We have so often urged the "small fry" (as another friend calls this class in which we all claim to rank) to send notes and items regarding their work, that we are blameless. Not only has the invitation been pressed, but the most ample provision has been made for these shorter articles.

When the departments of the GAZETTE were differentiated, "Briefer Articles" was established to receive communications of less than two pages. Later "Open Letters" was provided for those who chose to put items of interest, discussion or criticism into this form. And for the briefest, "Notes and News" is always waiting.

The GAZETTE does not print all MSS. which are sent to it. But we can truthfully say that no communication was ever rejected because it was too short or would interest only amateurs. On the contrary we welcome the notes by amateurs for amateurs, and lament the decrease of "briefer articles."

CURRENT LITERATURE.

The Myxomycetes of eastern Iowa.

The leading paper of the latest number of the *Bulletin* of the laboratories of natural history of the State University of Iowa [1] is a descriptive catalogue of the myxomycetes of eastern Iowa, by Prof. T. H. McBride. Sixty-six species are described, and most of them are beautifully figured on the ten plates drawn by Miss Mary McBride to accompany the monograph. Incomplete as it may be for its own locality and for others further removed, there are many botanists who have desired to know something of the group who will welcome this work, and will thank its author for the care and labor he has expended in its preparation. We trust that it is only preliminary to a fuller and more elaborate account of the species of the upper Mississippi valley. We suggest as an improvement for the next edition, that the author carry his "keys" further, to include the species of the larger genera, such as Trichia and Physarum. It is a help to the beginner, out of all proportion to the labor it costs the author, to have some clue to the species, after he has been led by keys to the genus.

The Missouri Botanical Garden.

The third annual report of this institution was issued about the first of June. The report of the director, Dr. William Trelease, is most interesting to those who are watching eagerly the progress of the garden, for it summarizes the improvements of the past year, certainly one of the most active since its organization. Besides the necessary work of maintenance, many repairs and improvements have been made. They have included excavating and remaking in a substantial manner many of the walks; extensive draining; resetting of edging for

[1] Vol. II, no. 2, pp. 99—162, pl. 10.—June 1892.

the beds; replacing all the sets of steps about the parterre; rebuilding from the foundation the west wing of the greenhouse and repairing it throughout; replacing unsightly and dilapidated wooden fences with open wire or iron ones; beginning to put the fruticetum into order by removing some of the old and useless trees, subsoiling about 5 acres, spading about one acre of it from two to two and a half feet deep, and planting a small orchard and a considerable number of shrubs. In addition to the introduction of many plants brought from the West Indies by Mr. Hitchcock, a very successful attempt has been made to introduce hardy native species into the grounds. About 1500 species were planted under the direction of Mr. F. H. Horsford; a bog and artificial pond and many small beds having been prepared in the arboretum. The trees are being labeled with white-bronze plates bearing the name in raised letters, while white celluloid labels have been found best for the herbs. The Engelmann and Bernhardi herbaria have been mounted and arranged. They contain about 155,000 specimens. Dr. Trelease has also donated his private collection, chiefly of fungi, containing about 11,000 specimens, and his library of 500 books and 3000 pamphlets. Mr. Shaw's city residence has also been taken down and rebuilt in the garden, in accordance with the directions in his will. It is now occupied by the herbarium and library, for which it at present forms commodious quarters. In rebuilding, it was made fireproof. The library now contains about 6,000 volumes, and receives a large number of exchanges.

This is truly a record of remarkable activity, and augurs well for the future. All that is done, is being done with reference to perpetuity and permanent value, a policy that cannot be too warmly commended.

Though so much foundation work is being done, immediate results in scientific lines are not lacking. The report contains a thoroughgoing revision by Dr. Trelease of the 21 American species of Rumex, illustrated by 21 full page plates; a complete recapitulation by Dr. C. V. Riley of the observations on the Yucca-moth and Yucca-pollination, together with descriptions of the species of Pronuba and its allies, illustrated with 10 plates: notes and observations on the species of Yucca, hy Dr. Trelease, illustrated by 23 plates; a description by Dr. Trelease of *Agave Engelmanni*, n. sp., with plate; and finally a short paper by Thos. A. Williams on the fruit of *Parmelia molliuscula* Ach., a lichen whose apothecia, hitherto unkown, were discovered by Mr. Williams on a specimen in the Engelmann herbarium.

In such a foundation for research, and in these early results, American botanists may feel a just pride!

The principles of agriculture.[1]

Under this title Mr. Winslow seeks to set forth the elementary principles of chemistry, physics, geology and biology so far as they affect domesticated plants and animals. We have nothing to say of the parts of the book other than the botanical, further than this, that they seem to be of about the same quality. In the physical chapter, for instance, we notice a tranverse section of a woody stem used to illustrate the "porosity of matter"! The chapter on plants wholly ignores the existence of any but the flowering ones. The consideration of these almost begins with the hoary yarn about the germination of seeds from the hand of an Egyptian mummy 3,000 years old. And what follows is not materially better. The embryo of the bean is said to be located at the "eye"; "seeds *are supposed* to contain a supply of nourishment sufficient to support the young plant until the ascending stem can reach the open air"; "a *shoot* called the radicle extends downward"; "the radicle is the origin of the roots of plants"; these are some sentences from the paragraphs on seeds. Mr. Winslow gravely argues that the directive force for the stems and roots cannot be light "as it has been found that the same directions are followed when a seed is sprouted in darkness." He therefore concludes that plants are "endowed with a kind of instinct similar to the instincts of animals." Heliotropic and nyctitropic movements "we cannot account for with certainty, in a scientific way."

The rise of the "sap" is due to "capillary attraction." The "material of the roots has a very strong attraction for water" so that the water is drawn up with considerable force, so much in fact that that "this force is sufficient to assist in the extension of buds and leaves in their growth. It is supposed to explain also the tall slender growth of crops in a wet season", in which case the author suggests that the plants are forced "out of their normal dimensions"!

Oh for a writer on elementary science who has some knowledge! However it may be in religious experience, it has been abundantly demonstrated that in science, out of the mouths of babes and sucklings praise has *not* been ordained.

Minor Notices.

MR. THEO. HOLM has prepared the "Third list of additions to the flora of Washington, D. C.", which has been published by the Biological Society of Washington.[2] About 80 species and varieties have been

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[1] WINSLOW, I. O.—The principles of agriculture for common schools. Large 12mo. pp. 152. Chicago: The American Book Co. 1891.

[2] Proc. Biol. Soc. Wash., Vol. II, pp. 105—132.

added since the last supplement by Knowlton in 1886. Numerous new localities are also given.

In 1868 Dr. G. L. Goodale published a list of the phanerogams of Maine, which has generally been known as the "Portland Catalogue." A second edition of that list has now been prepared by Mr. M. L. Fernald, [1] of Cambridge, Mass. The list incorporates the discoveries since 1868 and by marks gives some indication of the distribution of plants in the state. Mr. Fernald proposes a complete annotated catalogue later, and asks assistance particularly in the collection of cryptogams.

In a recent paper in the *Proceedings* of the California Academy of Sciences [2] Dr. Douglas H. Campbell gives a detailed account of the structure and development of the prothallium and embryo of Marsilia vestita.

A second edition of Webber's "Appendix to the catalogue of the flora of Nebraska" has been issued by Dr. Charles E. Bessey of the University of Nebraska.[3] In addition to the correction of a few minor errors and the rearrangement of the index there is a supplementary list of recently reported species by Dr. Bessey.

Two papers on the Hepaticæ have recently been distributed by their author, Mr. A. W. Evans.[4] His "Arrangement of the genera of Hepaticæ" is an attempt to bring together the genera of these plants which are best entitled to recognition into natural groups, with a citation of the place of original publication and the chief synonymy. It will doubtless be of use to students of this group. The other paper is "A provisional list of the Hepaticæ of the Hawaiian Islands" and is based upon collections made by D. D. Baldwin in 1875-6 as determined by Austin. Ten new species are described and figured, of which five are credited to "Austin MS."

The forest trees of Indiana are enumerated by Prof. Stanley Coulter in a pamphlet reprinted from the Transactions of the Indiana Horticultural Society for 1891. One hundred and eight species are found in the state. Concerning these Mr. Coulter has gathered much valuable information from his own observation, from MSS. material placed at his disposal, and from previous publications on the plants of the state, particularly as regards their distribution and economic importance.

[1] Proc. Portland Soc. Nat. Hist. 1892.

[2] Second series, vol. III, pp. 183—205, plate iii. April 19, 1892.

[3] Contributions from the Botanical Department of the University of Nebraska, new series, III. June 14. 1892.

[4] From Proc. Conn. Acad. Sci., vol. VIII.

OPEN LETTERS.

Pink and yellow pond-lilies.

Pink pond-lilies are very commonly sold in Providence at the card store of Mr. E. C. Davis. Correspondents can always purchase them here in good shape. What I write to record, however, is the presence now, in the same shop, of a bunch of these lilies which are of an exquisite shade of pale *yellow*. I never saw anything like them before. Both kinds come from Cape Cod. We used to have, according to George Thurber, a locality for the pink ones near Providence; it has long since vanished.

Mr. J. F. Collins has found *Lotus corniculatus* here.—W. W. BAILEY, *Providence, R I.*

NOTES AND NEWS.

Two forms of registering apparatus for studying transpiration are described by Messrs. Taylor and Frost.

THE MAY number of the *Student* opens with a sprightly sketch of Julius von Sachs by Mr. Hubert M. Skinner.

THE TWO PAPERS of botanical interest in the June number of the *Forstlich-naturwissenchaftliche Zeitschrift* are "the quality and structure of fir wood," by Dr. R. Hartig and "the influence of elevation on the temperature of the soil," by Dr. E. Ebermayer.

A LUCID SUMMARY of our present knowledge of the nature and origin of fecundation both in the plant and animal world is to be found in the February and April numbers of the *American Naturalist*. It is the text (and illustrations) of a lecture delivered by Mr. H. J. Webber of the Shaw School of Botany before the Alumni Association of St. Louis Medical College.

HERR AMM, under the direction of Prof. Detmer, has conducted a series of experiments on the intramolecular respiration of plants, by which he has demonstrated the direct dependence of this sort of respiration on temperature, and on the stage of growth of the plants. It increases up to the optimum temperature for normal respiration, and also with the age of the seedlings, up to nine days.—See *Ber. d. deutsch. bot. Gesells.*, vol. x ,heft 4.

A PRIZE of a thousand marks is offered by the Experiment Station of Middle Java for the best investigation on the causes and prevention of the disease of Sorghum which is characterized by the reddening of the fibrovascular bundles. The limit of time for the investigation will be announced later. Manuscripts have to be written in German, and the usual precautions for withholding the name of the writer from the committee of award are to be observed.

THE WISCONSIN ACADEMY of Sciences, Arts and Letters held its field meeting for 1892 at Ripon, Wis., on June 2—4. The plans of the committee regarding out-door work were completely blocked by the steady

rains. A preliminary paper on the flora of Dane county, Wis., was presented by Messrs. R. H. True and L. S. Cheney of the University of Wisconsin, and Prof. C. R. Barnes delivered the public address in the Ripon College Chapel on "Asa Gray."

DR. J. C. ARTHUR publishes in the May number of *Agricultural Science*, a paper read before the Society for the Promotion of Agricultural Science at its Washington meeting, on the physiological basis for the comparison of potato prudction. He concludes that to make fair comparisons the seed material must be of the same weight, roughness and number of pieces; and that if the tuber is divided, only the same regions of the same weight tubers are comparable.

W. C. SHANNON, Asst. Surg. U. S. A., as member of the Central Division of the Intercontinental Railway Commission has collected specimens of the natural history of the various regions of Guatemala embraced in the surveys of the Commission. Capt. M. M. Macomb, U. S. A., Engineer in charge, has turned over the entire botanical material to Mr. J. Donnell Smith for elaboration, and for distribution to the chief herbaria. These plants will accordingly form part of the extensive series entitled, *Ex Plantis Guatemalensibus quas edidit John Donnell Smith.*

AT THE LAST commencement of the University of Wisconsin two of the theses presented were of botanical interest. Mr. A. M. TenEyck read an honor thesis on the "Regermination of seeds." Mr. Ten Eyck has carried out a long series of experiments to determine the number of times seeds of various garden and field plants could be made air-dry without destroying their vitality. Some, notably the cereals, will stand an astonishing amount of this hard treatment, growing after as many as 12 desiccations.[1] For the degree of M. S., Mr. Rodney H. True presented a thesis "On certain species of the so-called orthocarpous Dicrana." This will be published as part of a revision of the Dicrana in preparation by Messrs. Barnes and True.

THE PROGRAM of the international botanical congress, to be held at Genoa between the 4th and 11th of September, 1892, has been issued. Sunday, Sept. 4, is devoted to a reception of the foreign botanists. Various excursions are planned during the week. All the sittings of the congress will be public. The official language will be Italian, but it will be free to everybody when speaking or in discussions to use whatever language he may be most familiar with. It was not considered advisable to fix any special subjects for discussion, but it is announced that the reform of botanical nomenclature will be treated in accordance with O. Kuntze's recent book! After the congress, the committee will print a brief account of the meetings and will publish also the original memoirs.

PAUL SCHOTTLÆNDER has found that the same differential standing of the sexual cells of plants is possible as Auerbach has demonstrated in the sexual elements of anamals. Sections of the prothallium of *Gym-*

[1] In the May number of the *Revue gen. de Botanique* M. Gaston Bonnier records some similar but much less comprehensive experiments on the revival of seedlings after complete desiccation.

nogramme chrysophylla showing both antheridia and archegonia were double stained by Rosen's method, which will be described in the next part of Cohn's Beiträge zur Biologie der Pflanzen. Under this treatment the bodies of the spermatozoa are colored intense blue, while the plasma and nucleus of the egg cell are red. We see possibilities of material aid in determining the homologies of the embryo sac structures by this process. Schottländer's paper is only preliminary to fuller researches and publication.

THE FIRST REPORT of the director, Prof. F. H. Snow, of the temporary station of the University of Kansas, which was established "to promote and conduct experiments for the destruction of chinch-bugs by contagion or infection," has recently been issued, and forms an octavo volume of 230 pages, with plates and map. There are three diseases of chinch-bugs studied by the station: the white-fungus disease caused by Sporotrichum globuliferum, the gray-fungus disease caused by Empusa aphidis, and the bacterial disease caused by Micrococcus insectorum. The fungous diseases thrive in damp weather and the bacterial disease in dry weather. In 1891 three-fourth of the attempts to artificially carry infection were successful. Reports were received from 1400 farmers.

THE INTENSITY of the breathing process in plants which thrive in shade compared with those which require full exposure to sunlight has been investigated by Adolf Mayer (*Landw. Vers. Stat.*, XL, 203). For one class he used house plants, such as Tradescantia zebrina and Saxifraga sarmentosa, and for the other class field plants, such as rye. The leaves of the house plants took up much less oxygen in the same time, than those of the field plants as compared either with their living volume or dry weight. From this he concludes that plants which thrive in the shade, while unable to assimilate as much nutriment as others for want of sufficient light, yet are able to provide the same excess by reason of the lower intensity of the oxidation processes.

WILHELM RAATZ describes and figures, in the Berichte der deutschen botanischen Gesellschaft x. 183, the tyloses which he has discovered in the tracheides of species of conifers. In the same journal (vol. vii) Conwentz had declared the existence of such structures in the wood of the trees producing amber. But Raatz holds that this rests on a false interpretation of the structures seen and that the true tyloses are now for the first time figured and described. They are quite similar to the same structures in the angiosperms but are much less common, apparently arising only in the wood near a wound; as if the energetic radial division of the cambium to cover a wound spread to the neighboring tissues.

THE HOPKINS SEASIDE LABORATORY, a department of the Leland Stanford University, has been located at Pacific Grove, California, and will hold its first session of five weeks, commencing June 27th, during the present summer. Pacific Grove is a sea-side resort on the southern shore of Monterey Bay, two miles west of Monterey, and the seat of the Pacific Coast Chautauqua Assembly. Through the generosity of the Pacific Improvement Company, a piece of land has been furnished, and a sum donated sufficient to erect a plain frame building; and by

the liberality of Mr. Timothy Hopkins provision is made for the equipment of the building, and for the future continuation and extension of the enterprise. The library and apparatus of the University laboratories will be used.

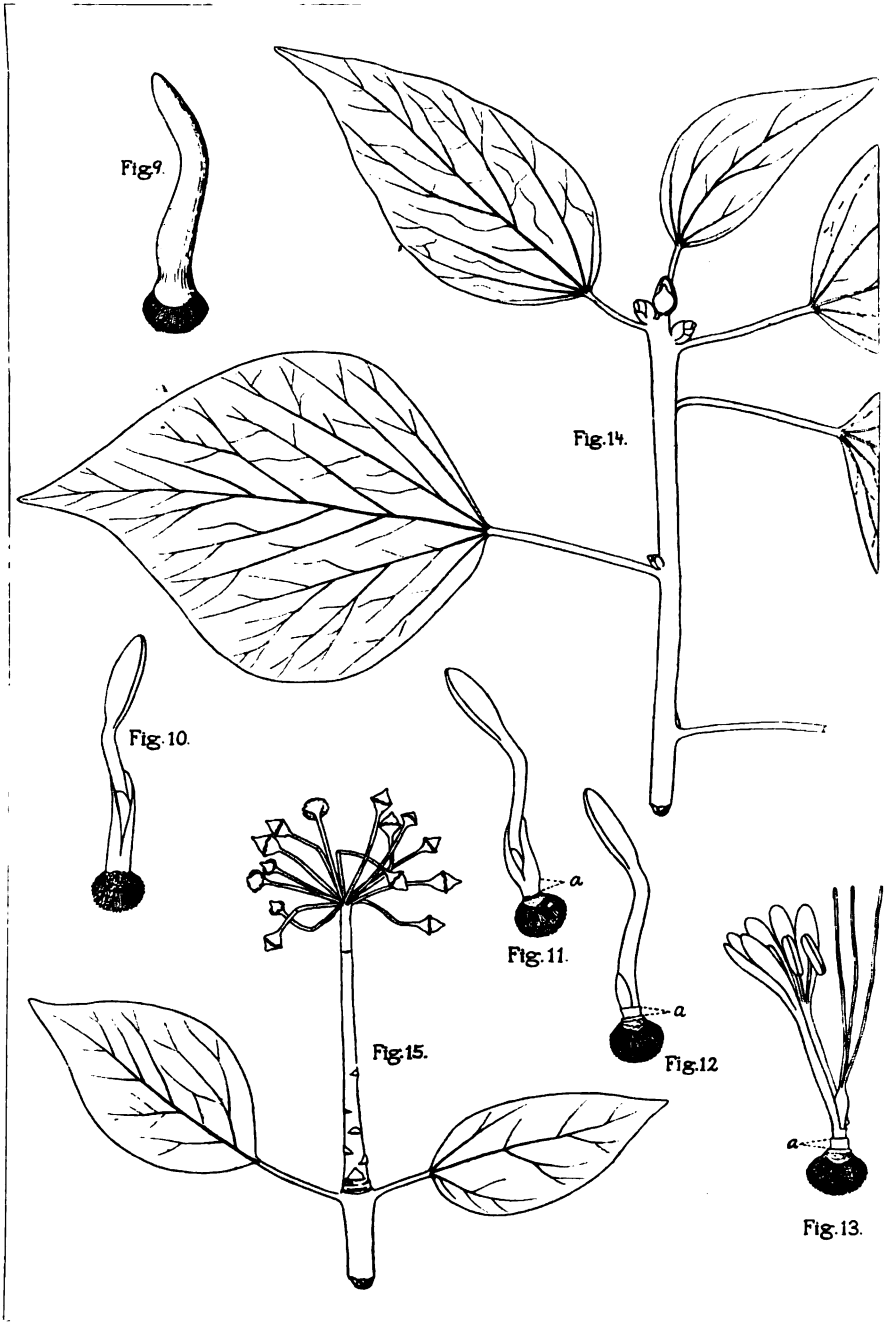
An elementary course in marine botany will be given by an assistant selected by Dr. Campbell, as the engagements of the latter will prevent his being present during this season.

IN THE *Annals of Botany* for April Mr. W. A. Setchell presents the results of his examination of the species of the genus *Doassansia*. He recognizes 12 species, of which two, *D. obscura* and *D. deformans*, are new, occurring on the stems of Sagittaria variabilis in Massachusetts and Connecticut. Two new genera, *Burrillia pustulata*, in honor of Dr. T. J. Burrill, and *Cornuella lemnae*, in honor of Prof. M. Cornu, are also described, the former from Illinois and Wisconsin and the latter from Massachusetts. In the same number, Dr. D. H. Campbell discusses the prothallium and embryo of *Osmunda* and suggests the bearing of the observed facts on the phylogeny of the ferns. Bacteriologists also will be specially interested in the article of Mr. H. M. Ward on the characters or marks employed in the classification of the Schizomycetes, at the conclusion of which he suggests the questions which should be answered by bacteriologists before they publish a species as new. These relate to habitat, nutrient medium, gaseous environment, temperature, morphology and life history, and special behavior.

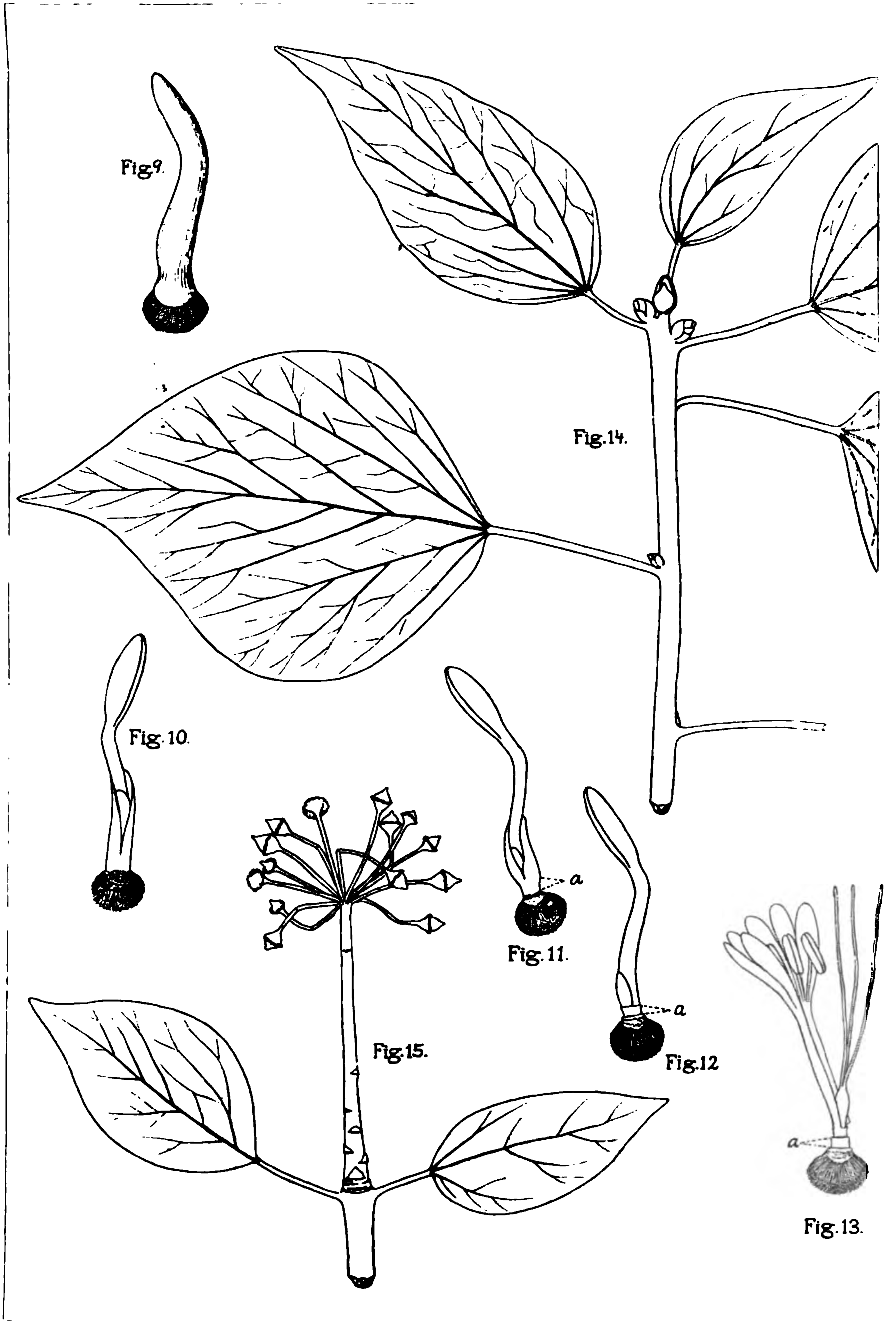
THE UNIVERSITY OF MINNESOTA has begun the publication of a *Quarterly Bulletin* under the editorial management of Prof. Conway MacMillan, and the direction of a board of editors appointed from the various faculties of the University. The following items of botanical interest are taken from the first number:

Work upon the botanical survey of the state is being pushed with vigor. Three collectors last season brought in more than 20,000 plants, covering in their exploration pretty thoroughly the valley of the Minnesota. This season four collectors are in the field. It is the intention to gather largely for exchange, with a view to strengthening the herbarium in plants of the southern hemisphere. The collectors will give special attention to the fungi, lichens and algæ.

Dr. Albert Schneider has in press in the Minnesota Academy a paper criticising Jumelle's researches on the influence of anesthetics on transpiration. (See this journal XVI, p. —.) His experiments lead him to the conclusion that ether *retards* transpiration by retarding assimilation, under all conditions. Jumelle's results were faulty in the use of parts only of plants and in confounding evaporation with transpiration. The increased loss of water vapor from anesthetized vegetable tissue is due to the alteration of the primordial utricle by the ether, allowing evaporation to take place.



FOERSTE on FALL BLOSSOMING.



FOERSTE on FALL BLOSSOMING.

BOTANICAL GAZETTE

AUGUST, 1892.

On the relation of certain fall to spring blossoming plants. II.

AUG. F. FOERSTE.

[PREFATORY REMARKS.—I regard the present paper as a continuation of that published in this journal, vol. XVII, p. 1. It is of wider application than the citations of European plants alone would seem to indicate. Its purpose is to set forth the general relations between certain fall and certain spring flowering plants, and to explain how some spring plants took up the habit of flowering in the fall. The paper is intended simply as a theoretical discussion. But such a discussion must rest upon facts. I do not know the plants of the southern United States well enough to cite these in illustration of my points. On the other hand the data on the flowering seasons of the plants of Italy and France are extremely rich The plants of these countries have been well observed for several centuries, and the frequency even of accidental times of flowering has been quite well determined by this time. The plants of these countries, therefore, furnished the desired data, data which I could not find at home. Moreover, I have had an opportunity to see many of the plants in question. I have a great quantity of notes bearing on this subject in addition to those offered in the paper, but it would have unnecessarily extended it to introduce these.

For the present, my studies of this subject, as regards European plants, may be considered finished. It is my intention, however, to study the similar cases which I expect to find in the southern United States. When it comes to a discussion of this material I will find it very convenient to have already placed on record the much better array of facts which are offered by these studies of the plants of France and Italy, data for which are much more complete. I think that while it must have struck observers before that certain fall flowering species were nothing but earlier flowering spring species, the presentation of a body of facts, like the present one, will draw more especial attention to studies of this kind; and will lead to an explanation of the fall flowering habits of other plants, where the real reason has formerly not been suspected. Perhaps one of the most important results will be the discrimination between the flowering seasons of various plants according to their *former* habits, a process which cannot be without value when it comes to a scientific study of phænology, plant climatology, etc.

I am well aware that modern botanical study is largely histological and morphological; yet I believe that there are still results worth obtaining in some of the older fields of botanical research, which, although not of the highest scientific rank, are yet worth cultivating, and constitute a part of botany in its largest sense.—*From a letter to the Editors.*]

I. If a comparative study of the flowering seasons of the plants of France, and those of Italy, Corsica, and Sardinia be made, the first feature likely to force attention is the greater proportion in the more southern regions of those plants which,

ordinarily flowering in the spring, also more or less habitually blossom a second time in the fall. This fall flowering of spring plants occurs with such regularity in the case of certain species that it is not uncommon to find the fact noted in the manuals of botany. The following list includes the chief species among those noted from Italy and the islands; and will serve to give a good idea of the wide range of plants among which this habit has been observed:

Fumaria parviflora, Morisia hypogæa, Cardamine hirsuta, Sinapis amplexicaulis, Iberis garrexiana, Reseda Phyteuma, Viola odorata, V. tricolor, Polygala vulgaris, P. flavescens, Silene paradoxa *sometimes*, Malachium aquaticum *sometimes*, Malva rotundifolia, M. borealis, Erodium maritimum, E. cicutarium, E. romanum, Potentilla Tormentilla, Lythrum acutangulatum *sometimes*, Trichera arvensis *sometimes*, Bellis perennis *rarely*, B. annua, Evax pygmaea, Centaurea aspera, Taraxacum officinale, Crepis bursifolia, Specularia speculum *often*, Erythraea maritima *sometimes*, Lycium europeum, L. afrum, Teucrium fruticans, Ajuga Chamaepitys, Salvia Verbenaca, S. multifida, Scutellaria Columnae *sometimes*, Lamnium album, Micromeria approximata, Globularia Alypum *in warmer places*, G. vulgaris *sometimes*, G. incanescens *sometimes*, Daphne collina *sometimes*, Daphne Cneorum *in certain Alpine regions*, Passerina hirsuta, and several species of Urtica.

A corresponding list from France would be considerably smaller. If species growing only in southern France, such as Ononis minutissima and Gentiana pyrenaica, were excluded, it would scarcely number a fourth of that of Italy. A corresponding list from Sweden would include but few species indeed. The explanation for these facts is very evident. In the more southern countries spring begins much earlier, and the warmer rays of the autumn sun linger much later than in the more northern ones. In Italy, therefore, many plants manage to flower a second time in the fall, owing to different reasons.

These may be that the seed produced by spring flowers had time to germinate and develop into a plant of sufficient size to produce flowers already in the same fall; or, the parching summer sun having produced an enforced rest in the case of certain species, the fall rains again called forth vegetation, and with it flowers; or, the same vegetative stalk, after having once flowered and produced fruit, began to blossom again, usually in an indifferent way, in the fall. In the more northern countries there is not enough time between spring and fall to permit many spring plants to develop this habit of flowering again in the fall.

Considering how long this habit of fall flowering has been noted in the case of certain species blooming normally in the spring, it is surprising that no studies should have been made

to ascertain to what extent these fall flowers succeed in ripening seed capable of germination in the following spring. Nor is the writer able to furnish this desirable information. It is to be presumed, however, until more definite data are at hand, that in a considerable number of cases these fall flowers do not produce seed capable of germination.

II. The fact that spring plants begin to blossom at a much earlier season in southern countries than in northern ones is of course known. But to those who are accustomed to consider the first of January as an ever-ready division between fall and spring, it may be a second feature of interest to notice that spring for quite a number of Italian plants may be said to begin at a yet earlier date. Thus species of Helleborus, Ophrys, and Narcissus begin to flower in Italy even in December. Other species blossom from fall to spring. Among the latter are Iberis semperflorens, October to April; Anagris fœtida, December to March; species of Calendula, November to March; Periploca lævigata, November to March; Lithospermum rosmarinifolium, December to April; Iris alata, November to March; and Arisarum vulgare, November to March in the more southern localities.

The following species blossom from fall to the middle of winter, but their relation to ordinary spring flowering species is unmistakable: Ranunculus bullatus, October to December; Helleborus niger, November to January; Bellis sylvestris, September to December; Thrincia tuberosa, October to December; Campanula isophylla, September to December, and Arbutus Unedo, October to January. Certain species are mentioned as flowering in the fall and again in spring: Koniga halinifolia, October, November, and again in April and May; Linum maritimum, November, December, and again in March. The close relationship of this habit to that of spring plants flowering a second time in the fall will be at once noted.

Three other species, apparently belonging to the same list, had perhaps better be described as fall flowering plants blossoming occasionally again in the spring: Bellis sylvestris, Mandragora vernalis and Colchicum autumnale.

A certain number of corresponding species are found also in France, especially in its southern portions, although less frequently than in Italy. From the middle of winter to spring: Helleborus niger, January to April; Petasites fra-

grans, December to March; two species of Erica commence flowering in January. From fall to spring: Arbutus Unedo, October to February; Passerina hirsuta, October to April. North of France flowering rarely begins sufficiently *early* to merit consideration in this connection.

The various short lists just mentioned indicate very well a sort of tendency which certain spring flowering plants have of flowering more and more early, so that in the case of certain species the flowering season begins early in the winter, and with others, already in the fall. The fall flowering species of this series differ widely from the cases of accidental, or more or less regular and repeated reappearance of flowers in the fall which was noted in the case of many plants at the beginning of this paper.

1. Fall flowering with the second series is *not* a case of the reappearance of flowers for the second time during the same year. 2. *All* of the species of this series ripen their fruit, although quite frequently not before the following spring. 3. Fall-flowering with them may be regarded as a matter of more or less gradual development, as the tendency to blossom early, carried almost to excess, and not, as in the case of the plants first discussed, a sort of sport of nature, which has assumed a more or less fixed habit with certain species.

III. After examining the various notes just presented, showing how some plants have come to flower in the fall, by methods totally diverse, the presence of a considerable number of species flowering only in the fall, and yet finding their immediate relatives with spring plants, can no longer be surprising. As might be expected, these species are more common in Italy and in southern France, than farther north. The following is a list of the species flowering ordinarily only in the fall in Italy, Sardinia and Corsica; the species printed in Italics occur also in southern France:

Ranunculus bullatus, *Ceratonia Siliqua*, Glinus lotoides, *Hedera Helix*, *Taraxacum gymnanthum*, *Erica multiflora*, *Cyclamen Europæum*, *C. Neapolitanum*, C. Poli, Daphne Gnidium, Triglochin laxiflorum, Posidonia Caulini, species of Crocus, Narcissus serotinus, *Sternbergia lutea*, St. colchiciflora, Leucojum autumnale, Scilla intermedia, *Colchicum autumnale*, C. Neapolitanum, *C. alpinum*, Arum pictum, Biarum tenuifolium, and Botryanthus parviflorus.

In addition to the above species in Italics, the following species entering from Spain, are also found in southern France, with the same habit of flowering in the fall: Viola arborescens, Androsace pyrenaica, Merendera Bulbocodium, and Crocus nudiflorus.

Of the various fall flowering species just cited only four have a geographical distribution extending further north than southern France. Cyclamen Europæum and C. Neapolitanum reach central France. Hedera Helix, and Colchicum autumnale extend considerably north of the northern boundary of France. The centre of geographical distribution for almost all these species lies therefore south of France, and in a measure the habit of fall flowering, as exemplified by these species flowering only in the fall, may be considered as a habit which originated in countries further south, which by a spread of the geographical range of the species was carried often as far north as southern France, but rarely surpassed this limit. There is not a single species in France flowering only in the fall, which does not in its geographical distribution reach Italy or Spain. This is an important observation, not only as indicating the respective places of origin of this habit (for the species here discussed) as just suggested, but also as indicating the probable method in which this habit originated, as will be seen presently.

IV. As has already been indicated, there are three methods in which species, flowering only in the fall, may have gained this habit: 1. They may simply be cases of more and more retarded development of flowers, ordinarily blossoming in the late summer. 2. They may be spring flowering plants, which, by a sort of freak of nature, managed to flower a second time in the fall, and then made this more or less of a habit. 3. Fall flowering may also be a result acquired by the continued application of the tendency of certain spring plants to blossom very early, some of them having succeeded in blossoming already in February, others in December, and the species in question even in November and October. Which of these three tendencies or methods is the cause of the fall flowering of the species last mentioned?

To a certain extent this question can be answered. In the preparation of the various lists quite a number of species were encountered which had developed the habit of fall flowering, by a simple retardation of the period of development of their blossoms. These species were usually detected by the fact that all their relatives were summer flowering species; there were no close spring flowering relatives, nor did the plants, in their habits or in any part of their structure, indicate that they had ever passed by the stage of a spring plant.

The names of these species have been purposely omitted in this paper, and yet it is possible that certain of the species mentioned under the third series (III) may have had such an origin. This may, for instance, be true of Viola arborescens, Ceratonia Siliqua, Glinus lotoides, Erica multiflora, Androsace pyrenaica, Daphne Gnidium, and Triglochin laxiflorum.

Ceratonia Siliqua has close inflorescences, in the axils of the leaves of the same year's growth, which blossom in September and October. This is remarkably retarded development for the flowers, considering that the subtending leaves are already formed in spring. On the other hand, these inflorescences may be branched, or even be developed together with a few leaves on short lateral branches; and no signs of a former existence as a spring flowering tree are shown by any remnants of organs protecting these inflorescences from the cold. Species of Erica often commence flowering very early in southern countries. Perhaps E. multiflora is only an accentuated case of this very early flowering. Androsace pyrenaica is only a later flowering form of the summer blossoming species. Daphne Gnidium is certainly only a retarded case of late summer flowering. Its name has been retained in the list simply to introduce the following remarks: Most species of Daphne have the flowers or inflorescences developed during the same season as the subtending leaves. In the case of a few species, however, the flowers develop from buds in the previous year's axils, the subtending leaves remaining persistent in Daphne Laureola, D. Philippi, and being deciduous in D. Mezereum, D. Blagayana, D. sericea, and, possibly, D. collina. The flowers of the latter species have, exteriorly, a woolly covering. Now, it is evident that, in case any of the species of Daphne were ever to take up the habit of flowering in the fall, it would be apt to be one of the early spring flowering series just mentioned, which have their buds already partially developed in the axils of last year's leaves, and which have already taken up the habit of flowering as early as possible, rather than the later spring flowering species which develop first from this year's axils.

The case of Daphne Cneorum, a spring flowering species which sometimes blossoms again in September, is instructive in this connection, in that it has not been possible to learn that the fall blossoms were accustomed to ripen their seeds. Triglo-

chin laxiflorum occasionally also flowers in spring. Tr. Barrelieri flowers in May. Tr. maritimum blossoms in June and July. There are no data at hand to discuss the usual fall flowering of the species first mentioned.

The remaining species of list III are considered as fall flowering plants which formerly blossomed in the spring. This remainder may be conveniently divided into two divisions, based upon their presumed former habits, species in which the flowers were probably never developed a long time before blossoming, and which, therefore, furnished no protecting organs for the flower buds against winter weather; and species which formerly developed their flower buds during the fall and kept them protected against the cold of winter in scaly and often subterranean buds before the final development and blossoming in spring. To the first division belong Ranunculus bullatus, Taraxacum gymnanthum and species of Cyclamen.

Ranunculus bullatus flowers in October, has scapes bearing single terminal blossoms, surrounded at the base by root leaves. It has altogether the aspect of a spring plant. Taraxacum gymnanthum flowers in September, much after the fashion of any dandelion which begins to blossom freely again in the fall, only this species does not, unless rarely, make its appearance in the spring. This species forms the best case of a plant formerly flowering in the spring, which *possibly* took up the habit of fall flowering as the result of the frequent continuation of the freak of nature in accordance with which spring plants sometimes flower a second time in the fall.

Among European species of Cyclamen the following blossom in the spring: C. repandum, March to May; C. latifolium, January to April; C. Coum, January to March. The following flower in the fall: Cyclamen Europæum, August to September; C. Africanum, November to December; C. Cilicium, September to October; C. Neapolitanum, September to November; C. Poli, September to November; C. Græcum, October to November. C. Europæum flowers probably most of the summer in some places further south. The other species all flower so decidedly in the fall or in the spring, and the related genera are so commonly spring flowers, that the origin of the fall flowering species of Cyclamen from former spring flowering ones seems very probable.

Fall flowering species, in which the plants show means of

protection of the flowers against the winter cold, are the following: Hedera Helix, Posidonia Caulini, Crocus spp., Narcissus serotinus, Sternbergia lutea, St. colchiciflora, Leucojum autumnale, Scilla intermedia, species of Colchicum, Merendera Bulbocodium, Arum pictum, Biarum tenuifolium and Botryanthus parviflorus. Of these species only Hedera Helix has aerial scaly buds. This species and Hamamelis Virginiana were discussed in a former paper. It was there also suggested that the scaly bud which in Hedera for some time encloses the flowering umbel is probably the remnant of a larger scaly bud which protected this umbel all winter, at a time when this plant flowered still in the spring. In Posidonia Caulini, the flower buds are protected by a sort of coarse bulb formed by the bases of the leaves. It flowers in October and fruits in February and March. B. Ardoino in his Flora des Alpes Maritimes, mentions a variety, P. major, as flowering in May and fruiting in August. The habit of P. Caulini to fruit in the spring is very suggestive of a former spring flowering history for this plant, especially when the habits of the variety major be considered. The coarse bulbs of this plant are probably most of the time covered by water.

The flower buds of the remainder of these species were formerly protected during winter in scaly subterranean bulbs, or in the scaly buds crowning subterranean fleshy corms. In the following remarks it has been thought best to draw into the discussion related species of Europe and vicinity.

Crocus. In a review of the genus by G. Maw, 43 species are described as flowering in the spring, often very early, and 26 species as blossoming in the fall; 10 of the latter have the leaves dormant during the flowering season. Whether the flowers appear in the spring or the fall, with or before the leaves, it is a general rule that the leaves attain their full development first as the fruit begins to ripen. Now as the fall flowering species develop their fruit first in the following spring it follows that the leaves of *all* the fall flowering species do not reach their full development until the following spring, the period of fruiting.

Narcissus. In a review of the genus by J. G. Baker only three fall flowering species are mentioned: N. serotinus, N. elegans, N. viridiflorus. Only in the first mentioned species are the leaves not contemporaneous with the flowers, its leaves usually not appearing until the scape dies down. All the

other species, here not mentioned, flower in spring, the latest until May. The relation of the fall to the spring flowering species is evident.

Sternbergia. Of the European species St. lutea and St. sicula blossom in the fall, together with the leaves, or the flowers have at first a slight start ahead of the leaves; St. colchiciflora blossoms in autumn, but the leaves appear first in spring with the fruit, thus pointing to a former spring flowering habit, as suggested in a former paper for the similar habits of Colchicum autumnale. St. Ætnensis still flowers in May, as though to remind the investigator of the former spring flowering habit of this genus.

Leucojum. Among European species L. roseum flowers in the fall with the leaves, but the leaves have scarcely made their appearance, or have only half the length of the flowering stem when the flowers begin to unfold. L. autumnale begins to flower in the fall also when the leaves are still concealed or just commencing to peep forth from the ground. Among the spring flowering species L. trichophyllum has flowers in blossom often when the leaves are still concealed, but the leaves may at times catch up in development during the flowering period. In L. vernum a slight difference of development is occasionally noted. The other spring flowering species, L. Hernandezii, L. æstivum, L. hiemale, have the leaves fully developed during the flowering season. The retarded development of the leaves of autumn species in general finds its analogy in many spring flowering species. It is not normal for late summer flowering genera or species.

The European species of Amaryllidaceæ present other good cases of fall flowering plants, although none of the species with this habit are found in France or Italy. Thus Lapiedra Martinezii flowers in Spain in September; Galanthus Olgæ flowers in Greece in October and November with the leaves; whereas G. plicatus, and G. nivalis flower in spring, when the leaves are not yet fully developed. Some of the species of Corbularia may sometime in the future take up the habit of fall flowering. C. Bulbocodium begins to flower often in January, and C. cantabrica, even in December, but at present their flowering season continues until March.

Scilla intermedia, which probably includes Sc. obtusifolia, flowers in October and November. The leaves start to grow after flowering has begun, a fact which is also true for Sc.

autumnalis, another fall flowering species, August to October. This habit points to an origin from spring flowering species; a case which otherwise would be doubtful since summer flowering species of Scilla are not rare.

Of the twenty-three well defined European species of Colchicum only one, C. bulbocodioides, flowers in the spring; it is interesting to note that it flowers together with the leaves. All the other species flower in fall, although a variety of C. autumnale, *vernale*, has been formed upon the frequent accidental spring flowering of this species, when for some reason the fall was not favorable for its flowering. The most frequent reason is that the meadows were covered with water during the fall. Among the fall species C. Bertolonii, C. pusillum, and the ill-characterized species, C. Steveni, develop the leaves almost simultaneously with the flowers in fall. The remaining twenty species develop the leaves first during the following spring. Now the habit of blossoming before the leaves develop is so common among spring flowering species, and so utterly unknown among summer flowering ones that this habit has been considered an excellent proof for the former spring blossoming habits of the species of Colchicum. This is further attested by the development of the fruit in spring.

A few other species of European Colchicaceæ may be mentioned in this connection.

Merendera attica has the flower stems and the leaves of the same length at the time of flowering, October to November, but the latter continue growth after the flowering season. M. Bulbocodium and M. filifolia have the leaves still hidden in the ground or scarcely started during the flowering season, September to October. The leaves, however, begin to grow rapidly before winter sets in. M. bulbocodioides flowers in October and November, but does not produce its leaves until early in February. M. sobolifera and M. Caucasica flower in the spring, but slightly ahead in development of the leaves.

Bulbocodium vernum flowers in March, considerably ahead in development of the leaves. B. ruthenicum also produces flowers before the leaves are well developed.

Schott, in his revision of the genera of the Aroideæ, proposes a new genus for Arum pictum, Gymnomesium, of which he says that it flowers in autumn, before the leaves appear. The new genus Biarum is also characterized as flowering in autumn, in September, before the leaves come out; but the

leaves appear during the same autumn, only later than the flowers. Biarum tenuifolium flowers in Italy, in October. In the specimens examined, the leaves were not visible at all when flowering commenced. Schott places in the same genus the following species: B. Spruneri, Greece; B. Anguillaræ, Dalmatia; B. abbreviatum, Greece; B. Zelebori, Greece, Asia Minor; B. Russelianum, Syria. From his characterization of the genus these species should have the same habits as the species first mentioned. The genus *Ischarum* Blume, as defined by Schott, also flowers in autumn before the leaves appear. Ischarum Haenseleri occurs in Spain, I. dispar in Algeria, and eight other species in Egypt and Asia Minor. The genus Leptopetion of Schott, flowers at Alexandria, in November, contemporaneously with the leaves. The case of Arisarum vulgare is very instructive in this connection. Considering only its habits in Italy and France, it may be said to flower from February to April in the north, and from November to March in the south. In some places, too cold during the middle of winter, especially in and near France, it flowers in autumn, and again in spring, but not during the middle of winter, except during mild seasons. On the other hand, in some very warm places, in some parts of the Riviera, and elsewhere, it is locally in flower chiefly from November to January, but not in later spring.

Botryanthus parviflorus flowers in September and October, together with the leaves. Most species flower in spring, beginning often in February, and the latest flowering in June.

VI. That part of list III which is discussed under § V is considered as including only those fall flowering species which formerly flowered in the spring. Their relation to spring flowering plants is shown in different ways.

1. In quite a number of cases all the related species which do not flower also in the fall flower in spring; and there are no related summer flowering species at all. (In those cases where summer flowering species exist, this proof is wanting.)

2. In quite a number of species the flower buds blossoming in the fall are protected in scaly bulbs or in the subterranean buds borne by corms until immediately before the flowering season, and then rapidly pushed forth and developed. This is a habit which seems to remain from the time when the plants flowered in spring and it was necessary to protect the flower buds as long as possible against the cold In Hamamelis

Canadensis the flower buds remain small all summer and do not develop until late in the fall. In Hedera Helix the scaly bud enclosing the flowering umbel does not develop in equal proportion with the rest of the plant for a considerable time after its formation, and therefore shows marked retarded development at first. This points, by analogy, to the long retarded development of buds during winter, to a former spring flowering habit.

3. Quite a number of species develop their blossoms more or less before the leaves. The leaves may develop later in the fall and during the winter, or may not appear until the following spring. This habit finds its analogy among spring flowering species and suggests the former spring flowering habit of these fall blossoming species.

4. A considerable number of the species in question mature the fruit first in the spring of the following year, although the fruiting capsule or pod may develop considerably during the winter months. In many species the fruiting ovary remains in the ground during winter for protection against the cold, as heretofore described for Colchicum. In Hamamelis Canadensis the pod takes on a horny texture which protects it against the cold, and the fruit of Hedera Helix is also quite hard during winter months.

By the use of one or more of these data the former spring flowering habit of fall flowering plants may be determined. It remains to learn if the fall flowering habit resulted from the occasional reappearance in fall of the flowers of certain species flowering in spring under ordinary circumstances, or if they are cases of earlier and earlier development of spring plants. The following facts are of importance in a consideration of this question:

1. When related spring flowering species are sufficiently numerous, as for example in Crocus, Narcissus, Colchicum, Merendera and the like, one or more of the spring species will always be found to commence flowering remarkably early, thus forming a sort of a link with the fall flowering species.

2. It is not common for the related spring flowering species to flower *a second time* in the fall, although related species may *begin* to flower in the fall and *continue* blossoming until spring, either on the same plant or in different plants of the same region, or in locations successively less favorable for early flowering.

3. If the two facts just noted are more favorable to the development of fall flowering species from spring species by means of successively earlier appearance of the flowers owing to the tendency of spring flowers to blossom as early as possible, a third consideration is still more decisive in this direction. The spring flowers which accidentally blossom a second time in the fall commonly do not ripen their seeds. Now by what kind of selection are these plants ever going to acquire gradually the habit of resisting the cold, and maturing their seeds even after a quite severe winter? If on the other hand, the ancestors of fall flowering species began as ordinary spring flowers, and then gradually flowered earlier and earlier, it may be understood how all these species found some means of resisting the winter cold, and all of them gradually acquired the habit of ripening their seeds in spite of the cold, either in the spring as usual, or in the fall. It is because the habit of flowering in the fall is viewed as the result of a *gradual* development with these species, that a simultaneous development of the power of the fruit to resist cold is also readily understood.

Moreover, the development of the habit of fall flowering in the manner just cited requires that the habit of flowering in the fall should be formed in the warmer, more southern countries where it is possible for plants to blossom during the winter months under certain circumstances without being totally destroyed by the winter frosts. Now as a matter of fact these conditions are present in some parts of southern France and the countries farther south. This explains why there is no genuine fall flowering species in the sense here considered, and included in the list III, which does not have its geographical range extending into the districts of southern France, and farther south, into Italy, Spain, or Corsica and Sardinia, and also why the centre of the area of geographical distribution for these species lies usually in the more southern countries mentioned.

It is therefore believed that the fall flowering species of list III above investigated derived their habit of flowering in the fall in Spain, Corsica, Sardinia, the Riviera, Italy, or some other southern country, and that from their various places of origin these species extended their geographical range in all directions, and among others, more or less northward.

Moreover the considerations here adduced are believed to be also valid for plants showing a similar fall flowering habit under similar circumstances in other countries.

Cambridge, Mass.

Notes on the flora of Chicago and vicinity.

E. J. HILL.

From time to time the writer has furnished the BOTANICAL GAZETTE with lists of plants from the neighborhood of Chicago, and especially from the adjoining pine-barren region of northwestern Indiana, accompanied by such notes upon them and their distribution as seemed desirable. The present notes are in continuation of this work. Some of the plants to be noticed have already been mentioned in Higley and Raddin's "Flora of Cook county, Illinois, and a part of Lake county, Indiana," which appeared in the spring of 1891. Some have been detected since that time.

NATURALIZED PLANTS.—Of naturalized plants, either weeds or useful plants, the following may be mentioned:

1. *Nasturtium sylvestre* R. Br.—This European plant, well established in the Atlantic coast states, though rare, is quite abundant near Western Springs, a village nine miles west of the city. It grows along a highway north of the village, flourishing in the clay soil, and spreading from wayside pond holes up to the wagon tracks, where it is subject to a goodly amount of dryness at some seasons. Where the road crosses Salt Creek, a neighboring stream, the plants have spread in the rich, damp soil of the open woods along the creek. Some plants had gained a footing in the scanty soil lodged in the crevices of the stone masonry forming the retaining walls of the approaches to a bridge spanning the stream. A habit so unusual for a nasturtium shows its hardiness and persistence, and indicates that it has come to stay. The locality is in the midst of cultivated fields and meadows.

2. *Trifolium hybridum* L.—It is stated in the "Flora of Cook county," already mentioned, that a few specimens of this have been found near lines of railroads from the east. In 1886 I found it common in a field near Forest Hill, in the the southwestern part of the city. Clumps of it were growing in a meadow about as freely as those of red clover, and it had spread to the adjoining street. It was so plentiful as to lead one to think it may have been sown along with the tame grass of the field.[1]

3. *Medicago sativa* L.—The only place where I have met with alfalfa is in a meadow near East Chicago, Ind., where it

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[1] This species is abundant near Madison, Wis., thoroughly established and spreading rapidly.—EDS.

grows spontaneously in the grass. The farm where it occurs is an old one for the locality, being cleared in early days in the pine woods, and is still encircled with timber. It is not reported elsewhere in the vicinity of Chicago.

4. *Helianthus annuus* L.—This is not the cultivated plant escaped from gardens, but one introduced from the plains. It is well established in the western part of the city, near Brighton Park and along the C., B. & Q. R. R. The locations reveal how it has been brought here, as it is seen most abundantly where the refuse from stock trains has been thrown out of the cars along the embankments, or piled in the fields. It has spread from such places into the neighboring fields, and is sharing the ground with *H. grosse-serratus*, the most common indigenous helianthus in such situations. The heads of flowers are quite variable in size, the disks an inch or two in diameter, and are mostly larger than any of our wild sunflowers, and with a different aspect.

5. *Solanum rostratum* Dunal.—I came across this first in 1886, near Liverpool, Ind., and it was reported in the BOT. GAZ., XIII, 323. The same year it was found at South Chicago, as mentioned by Higley and Raddin. In 1890 I found it at Dune Park, Porter co., Ind., along the L. S. & M. S. R. R., somewhat farther east than the station at Liverpool, on the Pennsylvania line. I have not yet seen it in any field.

6. *Amarantus blitoides* Watson.—This is now very common by the railroads and highways leading into the city. It is not difficult to determine very nearly the time of its appearance at Chicago. I noticed it at Englewood in 1875, having come here to reside the fall before. Not finding this amaranth described in the current hand-books, specimens were sent to Dr. Gray for determination, which was kindly done, and the statement added, "pretty common west." It is not mentioned in Babcock's "Flora of Chicago and Vicinity," published in the *Lens*, the last part of which was issued in December, 1873. Speaking to him about the plant sometime after it was found, he stated that he was aware of its presence south of the city, but had not seen it at the time his flora was compiled. It evidently came in from the west or south about that time, as it was not uncommon by the roadsides in Englewood in 1875. It is not given in Patterson's "Plants of Illinois" (1876), nor in the "Catalogue of Plants of Indiana (BOT. GAZ., 1881), nor in Wheeler and Smith's Michigan catalogue

(1881). As the last edition of Gray's Manual states that it has spread eastward to western New York, it has evidently gone this distance since about 1873. It is often a very vigorous grower, the prostrate stems sometimes three or four feet long, covering the ground like a mat, and producing seed in great abundance. Though the foliage resembles that of *A. albus*, the general appearance of the plant is very different from that of the globular and bushy tumble weed.

7. *Cycloloma platyphyllum* Moquin.—It is stated in Gray's Manual (6th edition), that this western plant extends to western Illinois and southern Indiana. It also occurs here and was first reported in Babcock's list (supplementary part, December, 1873), as "rare" by the I. C. R. R. In 1875 I found it growing by the C., R. I. & P. R. R., near the normal school in Englewood. Last year I saw it by the L. S. & M. S. R. R., between Miller's and Dune Park, Ind. It also occurs at the city of Evanston, north of Chicago. From its behavior, and the places where it grows, near the lines of railway, it is plainly adventive, having appeared doubtless about the time Babcock mentioned it. It is spreading eastward, and may be looked for further along on the railroad lines extending to the east. Macoun, in his "Catalogue of Canadian Plants" (1886), reports it as already in the streets of London, Ont., and remarks concerning it, "Fully established and spreading, an importation from the west."

8. *Salsola Kali* L.—Reported in Higley and Raddin's "Flora" as frequent on the lake shore at Evanston. In 1890 I obtained it in two localities east of the city, Wolf Lake and Clarke, Ind. Both are on the Penn. R. R., from a mile to a mile and a half from the shore of Lake Michigan. Evidently the plants were not derived from the Evanston locality, but were introduced in some way by the railroad, as they were close by the tracks or between the rails, and in very dry ground. Being a sea shore plant at the east, and one of river bottoms in northwestern Nebraska and central Dakota, with stations in southeastern Dakota (Yankton), and northwestern Iowa (Emmet Co.), and southern Wisconsin (Madison), the localities about Chicago are somewhat intermediate, and the plants may have been introduced from the east or west. It is clearly adventive at Clarke, and has all the appearance of it at Wolf Lake, and is so regarded by the authors of the "Flora" at Evanston.

NATIVE PLANTS.—There are a few plants of a different character, native to the region, which are worthy of mention.

1. *Desmodium Illinoense* Gray.—Found last year at Auburn Park within the limits of the city. It has been known hitherto as a plant of western Illinois and westward. From the locality where it grew it was evidently indigenous, and may occur elsewhere in this vicinity, as it is easily overlooked from its close resemblance to one or two other species of this troublesome genus.[1]

2. *Rosa setigera* Michx.—In the summer of 1890 I came across a few bushes, or clumps of bushes, of this rose at Willow Springs, in the southwestern part of Cook county, Ill. They were on the wooded hills which rise abruptly on the east side of the Desplaines river. They grew on the borders of rather wet spots, covered with sedge and coarse grass, little prairie-like openings often seen in the woods which crown the low drift-hills of this region. None of them were climbing, being too far from any support. Some of the growing shoots of the season, arching over and with the ends trailing on the ground, were six to eight feet long by the middle of July. Being in full bloom, with some of the masses of bushes several yards across, they presented a very attractive appearance, as it was my first sight of the climbing rose in its wild state. The first impression was that they were escapes from cultivation, but a careful examination of the locality led to a different conclusion. A year later the species was found on the west side of the Desplaines, a couple of miles below. In a narrow strip of woods between the river and Flag Creek, which enters it at this point, they occur plentifully, clambering over shrubs and climbing small trees. These stations seemed to have eluded the vigilance of local collectors, for the species had hitherto the following record for the vicinity of Chicago: "But two specimens have been found, one at Morgan Park, the other at Desplaines." In Patterson's catalogue of the plants of Illinois its most northerly locality reported was Peoria county, where Dr. Brendel found it. All of these stations are in the basin of the Illinois river, or close by, the Desplaines being its tributary, and Morgan Park being situated on the dividing ridge between it and Lake Michigan. The prairie rose is rare in Michigan, though one of its common names is the Michigan rose, but is considered indigenous there.

[1] Reported as found at Ann Arbor, Mich., in Beal and Wheeler's Michigan Flora (1892).

3. *Rosa Engelmanni* Watson.—Specimens of this were obtained last year at Pine, Ind., with oblong-obovate fruit. Those seen before in this vicinity have nearly always had oblong fruit, as mentioned in a former communication to the BOTANICAL GAZETTE (XV, 310.) The canes were from four to eight feet high, and closely resembled in foliage and fruit taller examples of this rose seen at Vermilion Lake, Minn., in 1889. As compared with *R. blanda*, it is usually a taller and more robust shrub, with abundant leafage, the stems, particularly the lower part, often densely covered with fine prickles. It prefers damper and generally more shaded situations, approaching in this respect *R. Carolina*. It partakes of another character of *R. Carolina*, which is not so common In the case of *R. blanda*, that of frequently being massed in iarge clumps, and occupying the ground quite exclusively. I detected this rose last year at Rogers Park, near the lake shore in the northern part of Chicago.

4. *Cacalia suaveolens* L.—Found in a single locality by the Calumet river, near Porter, Ind. It has not before been reported from this part of the state, nor from the vicinity of Chicago, though said by Dr. Phinney to be common in the eastern-central part of Indiana. Only one locality is assigned to it in Michigan, on the authority of Winchell's catalogue.

5. *Epigaea repens*.—Though common at Michigan City, Ind., and extending from there north through Michigan, this plant has lately been found coming farther west around the head of Lake Michigan. Near the mouth of West City creek, north of Porter, it grows in the open sandy woods along the lake. As this stream drains the swampy land lying between the two lines or ridges of sand hills which here run somewhat parallel with the shore, it may extend up the stream still farther towards the west. In the Catalogue of Indiana Plants it is reported from Lake co., Ind., but none of the local lists give it, nor do I know of its presence here on the authority of collectors from this vicinity. Though a frequent plant on the east side of Lake Michigan, especially as one goes north, it seems to be rare on the west shore, or entirely absent, until the northern peninsula of Michigan is reached, whence it extends westward around Lake Superior into Minnesota. It has been reported from Beloit, Wis.

6. *Quercus Muhlenbergii* Engelm.—This oak comes into our

lake flora sparingly, being found by Wolf Lake just east of the Indiana line. The soil is sandy and of little strength, so that all the trees are small. They are scattered over an area of a few acres, and are quite isolated in their position. Southwest of the city this oak occurs again on the Desplaines below the mouth of Flag Creek. In the rich soil of the bottom land it makes a large tree. These are the only localities near Chicago where it is at present known to grow. About fifty miles south it is not uncommon by the Kankakee river. *Q. imbricaria* comes a little further north along the Desplaines and Flag Creek, thence extending south to Joliet and beyond.

7. *Eleocharis quadrangulata* R. Br.—Abundant in the shallow water of Wolf Lake, but within the city limits. In the Manual its range is not extended west of Michigan. It has been found in Illinois and Missouri in the vicinity of St. Louis. In Wolf Lake it very fully occupies the ground where it grows, preserving the character Elliott gives it in his "Sketch," (I, 79.) "In rice fields it becomes a very injurious intruder, as its thick creeping roots occupy the ground, and permit nothing to grow where they extend."

8. *Eleocharis olivacea* Torr.—While looking the past season for *E. capitata* R. Br., since the only station where it had hitherto been seen, at Whitings, Ind., seemed likely to be destroyed by the works of the Standard Oil Company, I found it again about a mile from the original locality. The new station is on the borders of Lake George. With it *E. olivacea* was also found. Both are quite plentiful in patches in the wet, marly sands in which these shallow lakes abound, since the fresh water mollusks are so prevalent that their comminuted shells form a whitish marl. Such a soil affects the flora to some extent. It is in this fine mud, a mixture of sand and calcareous earth, that these two species of Eleocharis grow. Both are densely cespitose, forming small tufts. The stems of *E. capitata* are erect or ascending, from half an inch to seven or eight inches high, and form fibrous, annual roots, while those of *E. olivacea* are diffuse or subdecumbent, from two to four inches long, and grow from a perennial rootstock half an inch to an inch in length. They fruit about the same time, the latter part of August and in September. Both are largely plants of the Atlantic coast region. *E. olivacea* extends to western New York and by Lake Erie to Erie, Pa. It is also said to occur

in Michigan. In Indiana it is reported from Gibson county, in the southwestern part of the state, and the station at Whitings places it in the extreme northwestern part.

9. *E. intermedia* Schultes.—This species also was obtained with the two just mentioned. It has been noticed but once before in our vicinity, at Hyde Park. The stems are considerably shorter than those usually described, being but two to four inches long. They are spreading or declining, densely cespitose, many small bunches making a large, compound tuft. I do not find it reported for Indiana, though it is found in Michigan, northern Illinois, Iowa, and northward. *E. acicularis*, everywhere common, grew with the three species named above, and the four could sometimes be collected within the area of a square yard.

Englewood, Chicago.

The plea of expediency.

N. L. BRITTON.

Inasmuch as Dr. Sereno Watson has in his last published words (BOTANICAL GAZETTE, June, 1892) defined his position and that of Dr. Gray, on the question of nomenclature, as one of expediency, it is desirable that this position be briefly examined.

It is very clear from the manner in which these botanists have illustrated their position in their writings, that it has been an individual rather than a general one. By this I mean that what has appeared to them "expedient" is the course which has been followed quite independently of what others may have so regarded, and it is this spirit which has led to all the antagonism which has been developed on the question of what specific name a plant should bear, as well as in many other questions during the last twenty-five years.

This epoch has been forcibly defined in a late issue of the GAZETTE (p. 164) as one of "a botanical aristocracy," during which there has been a good deal of "rank injustice done to both worthy but unknown, and known but underrated botanists." Coming from the source that this pungent statement does, from one who has been more closely identified with the

work of the "botanical aristocracy" than any one else,[1] it must be accorded the greatest weight as an indication of the thoughts that have been rather freely expressed in private, and which have done systematic botany no good. A proper consideration of the wishes and opinions of others would have served science immeasurably better and redounded to the credit of those who were so well equipped to facilitate the development of botany in America.

As to the maintainance of the oldest binomial, the principle which Dr. Watson avers has been followed, so many exceptions have been taken in Gray's Manual and Synoptical Flora, that we perceive the principle of expediency has been made to work both ways. I will not refer to these in detail at the present time, but they may be illustrated by such well-known species as *Jeffersonia diphylla* (L.) for which Barton's binomial of *J. binata* is much older; and *Eclipta alba* (L.) taken up instead of *E. procumbens* Michx. Quite a long list of these could be given to show that the "aristocracy" of the GAZETTE did not hesitate to abandon its own avowed principles when deemed expedient. Now with these facts before us, when the time came that two or three American botanists not controlled by the "aristocracy" were by nature impelled to think for themselves, there were about two courses open to them. The one was to accept the recommendations of the Paris Congress of 1867, and other representative deliberative bodies which had considered the nomenclature question, and decided that the earliest specific name should be maintained; the other was to follow what has been termed the "Kew rule" of maintaining the oldest binomial. It is not worth while to discuss here the merits of the two systems; that has been repeatedly done by adherents of each. We saw that the rule of 1867 had the support of more botanists of eminence than the other and it appealed to us as the proper course. Its very general acceptance outside of the "botanical aristocracy" during the last five years has I believe fully demonstrated the wisdom of our choice. The opinion of the leading spirit in the Paris Congress of 1867 does not accord with Dr. Watson's idea that this is not an *ex post facto* law. It would indeed be ridiculous to have it so.

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[1] Dr. Britton is of course at liberty to make his own use of this editorial. The editors, however, beg leave to dissent both from his imputation of it to any one of their number, and from his special application of it in the case under consideration.

For some reason which I am wholly at a loss to understand, Dr. Watson found it expedient to intimate that I have withheld from publication a letter on this matter written by Dr. Gray. The facts in this case are just these. Immediately before his fatal illness, Dr. Gray wrote me a long personal letter objecting to the course which I had taken in maintaining one of Walter's specific names, dating from 1788, which was cited in Dr. Watson's Bibliographical Index, as a synonym of one published by Torrey and Gray in 1840. The citation is made by Dr. Watson without any question being thrown upon the equivalency, and I supposed it to be true, but in this letter Dr. Gray threw doubt on it, and informed me of an earlier specific name by Linnæus, which I took up on the next occasion I had to refer to the species. Some time after Dr. Gray's death I was requested to send this letter back to Cambridge as the physicians attendant on Dr. Gray desired to have a study made of the hand-writing. This I immediately did. Later I was requested to allow the letter to remain at Cambridge and accept a copy of it in exchange. As the last writing of a distinguished botanist I naturally valued the document, but acceded to the request, and the original is not in my possession. The letter did not come to me as editor of the *Bulletin* of the Torrey Botanical Club, for I was not then editing that journal. I did not realize that it was intended for publication, and do not think that it was. At any rate under the circumstances stated above, I certainly never had any right to publish it after it had passed from my possession, and there was no principle enunciated in it which was not already well-known as being held by the writer.

Columbia College, New York City.

BRIEFER ARTICLES.

On Amarantus crassipes. (WITH PLATE XVII.)—Schlechtendal publishes the first description of this species in Linnæa VI (1831), p. 757. Schrader, in Index Sem. hort. Goett. (1835), described this plant as *Scleropus amarantoides*. Shortly afterwards Endlicher, in Gen. Pl. Suppl. (1836–1840) p. 1377, published a description of Schrader's genus. Moquin, in DC. Prodr. XIII, 2, (1849), p. 271, retained the generic name, but restored the first specific name. Dr. Gray, in Proc.

HOLZINGER on AMARANTUS CRASSIPES.

Am. Acad. v (1862), p. 169, remarks that "the genus *Scleropus* was evidently founded upon an abnormal character, a thickening of the peduncle and pedicels, which occurs in various Amarantaceæ. Schrader's [it should be Moquin's] *S. crassipes* is an *Euxolus*, etc."

Bentham and Hooker, in Gen. Plant. (1883), p. 29, accept Dr. Gray's opinion, and include this plant under *Amarantus*, together with *Euxolus*, *Mengea*, *Amblogyne* and other of Moquin's Prodromus genera. Finally, Hemsley, in Biol. Cent.-Am. III (1882–1886), p. 14, includes this species with all its synonyms under *Amarantus polygonoides*.

A mere glance at the two plants is sufficient to excite doubt as to the correctness of this course. Closer inspection leads to positive certainty that Schlechtendal's plant, while remarkable for the thickening of its peduncles, is not an abnormal condition, and is specifically distinct from the plant with which Hemsley has united it.

In the first place, the histological investigation of these incrassate peduncles shows normal tissue. Certainly the thickening is not due to insect or fungus work. And the idea that we have here a case similar to the fasciation in the coxcomb, for instance, is refuted by the *uniform dichotomy* in the short clusters of inflorescence, sessile in the axils of which are the pistillate flowers. In this particular, as indeed in the entire description of this plant, Schlechtendal is scrupulously correct. He expressly mentions this thickening as constant in a large series of specimens before him. These were all from the island of St. Thomas, in the West Indies. The specimens in the National Herbarium comprise Wright's Cuban plant number 2033, Curtiss' Florida plant number 2378, Blodgett's Florida plant, Letterman's Texan plant *in part*, Dr. Mohr's Alabama plant, and Simpson's Florida plant number 482, collected this spring. It thus appears that this peduncular thickening is as constant, both in time and in geographical distribution, as it is remarkable.

But, apart from these striking peduncles, the plant has flower and fruit characters that entitle it to specific rank. The spatulate sepals of its pistillate flowers have *one* green mid-vein; the ovary has *two* styles; the ripened utricle is *indehiscent*. In *Amarantus polygonoides*, on the other hand, the sepals, also spatulate, have, in addition to the mid-vein, *two lateral* veins; the ovary has *three* styles; the ripened utricle is *circumscissile*. The seeds also of *A. crassipes* are one-third larger than those of *A. polygonoides*.

Schlechtendal found no staminate flowers in his plants. The later authors state that they occur solitary in the axils of the upper leaves. The writer has uniformly found them solitary at the base of the flower

clusters toward the upper part of the stem. The sepals are four, occasionally five, narrowly triangular-lanceolate, with a green mid-vein; the stamens are three, as described, but sometimes only two, rising from a small round disk in the bottom of the calyx; the two-celled oblong anthers are little shorter than the filaments.

As to bracts: the author of this species states correctly that the branches of the inflorescence are each subtended by an ovate-triangular, acute, small, appressed bract marked by a green mid-vein. This reaches up to the one flower which terminates each branch, and is the only bract that can be considered as belonging to that flower. Yet the flower is distinctly jointed to its pedicel *above* the bract; so that strictly speaking it is the pedicel, and not the flower, that is uni-bracteate. Endlicher, Moquin, and their followers, describe the flowers as *tri-bracteate,* an error which seems to have arisen by looking only at the terminal flowers of each cluster. For only in that case are there three bracts, one subtending the branch on which the flower rests, and two, opposite each other, subtending the rudimentary continuation of the dichotomy. See fig. *e*, plate XVII.

Another error, also initiated by Endlicher, is the statement that the style is "very short," and the stigmas "two, filiform." The artist has drawn these parts correctly in the accompanying plate. And the author of this species is here also right when he says, "Styles two, diverging, curved outward, stigmatic all down the inner side." These stigmatic surfaces are under the lens densely long-papillose. Fig. *g* shows the direction of styles at the time of blooming; figs. *f* and *k*, at the time of maturity. The author evidently described them in the young state.

By its spatulate sepals this plant is related to the section *Amblogyne;* by its warty, indehiscent utricle, to *Euxolus;* by its uni-bracteate flowers, to *Mengea.* But by its other characters it is distinct from all, and deserves to stand in a section by itself, § SCLEROPUS, under its *first* name, *Amarantus crassipes* Schlecht.—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

EXPLANATION OF PLATE XVII.—Fig. 1. Upper part of a plant of *Amarantus crassipes,* nine-tenths natural size, showing mucronate apex of leaves. Figs. *a, b, c, d.* Flower clusters showing the mode of inflorescence. Fig. *c* is from a younger flower cluster with pedicels not yet fully incrassate. Fig. *e.* Terminal flower, with "three bracts." Fig. *f.* A pistillate flower, with mature utricle, with part of subtending bract on the pedicel. The joint under the flower is also shown. Fig. *g.* A younger pistillate flower, the pistil separated from the calyx. Figs. *h, h'.* A sepal of this plant, and of *A. polygonoides* respectively. Figs. *i, i'.* Seeds of these two species. Fig. *k.* A pistillate flower with a staminate flower at its base. Fig. *l.* Part of a staminate flower showing the small disk at the bottom of the calyx.

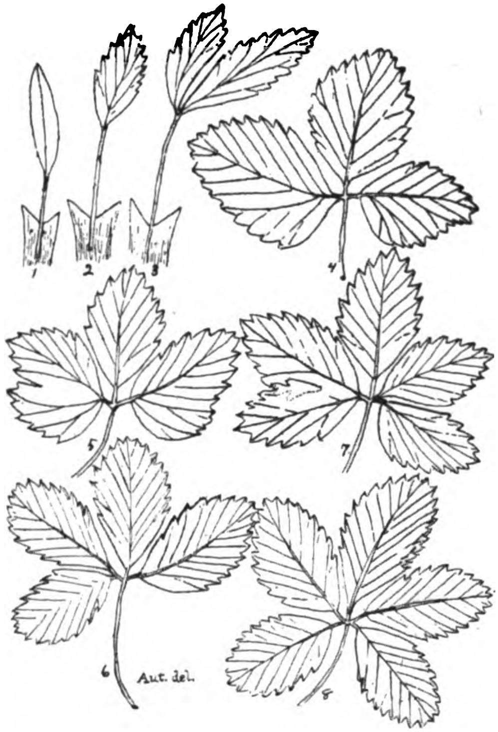
Interesting variations of the strawberry leaf.—The strawberry, both wild and cultivated, is perhaps considered less inclined to variation of foliage than many of our common plants. I have often sought in vain among them for an abnormal leaf. There are so many strawberry leaves in which the lower portion of the two lateral leaflets is conspicuously enlarged, that one is led to expect the advent of additional leaflets. In other words it sometimes appears as if nature were planning to inaugurate a five-leaved form. There is often apparently overgrowth sufficient to form an extra leaflet. Indeed the lateral leaflets become so lopsided, on account of this excessive growth, that symmetry demands that the lower portion be cut off and made into a separate leaflet. Plants all about us are moulding their leaves in accordance with changing conditions. They have found by long experience in the struggle for life, that, oftentimes, many small leaves serve their purpose better than a less number of larger ones. And so we find many entire leaves indenting their margins; lobed ones becoming more deeply lobed; still others, by what we may term an evolutionary process of division, give rise to new or additional leaflets. From the lateral leaflets of the strawberry, for instance, other leaflets might be expected to be evolved or developed.

This process may be observed in very many of our common plants; it was therefore with much pleasure that the conservative strawberry was, this past season, found falling into line with other progressive plants. In a small strawberry patch some thirty or forty large, vigorous, thrifty looking leaves were found which had progressed beyond the present trifoliate form. The new or added leaflets appear, just where I had hoped to find them, on the lower side of the lateral leaflets, where the surplus growth seems to have been made in anticipation of such a forward step. Figs. 5, 6, 7 and 8 (reduced one-half) represent a series of these leaves. Many more gradations might be shown were there space sufficient. But these will serve to illustrate that the strawberry is not standing still; that it is moving along the same lines traversed by the blackberry, the Virginia creeper, etc.

The finding of these "abnormal" leaves, brought to mind some interesting leaves of Fragaria Virginiana, var. Illinoensis, which were collected near Lexington, Ky., some ten years ago. Figs. 1, 2 and 3, (half natural size) represent gradations of these suggestive leaves. Duplicates were sent to Dr. Gray at the time, but he considered them "merely abnormal forms, which sometimes occur."

Is it not possible, however that the single leaf, fig. 1, is the primitive or ancestral type of our present trifoliate form? Evolution carried this type to the plane upon which we find fig. 2, in which the crenate-

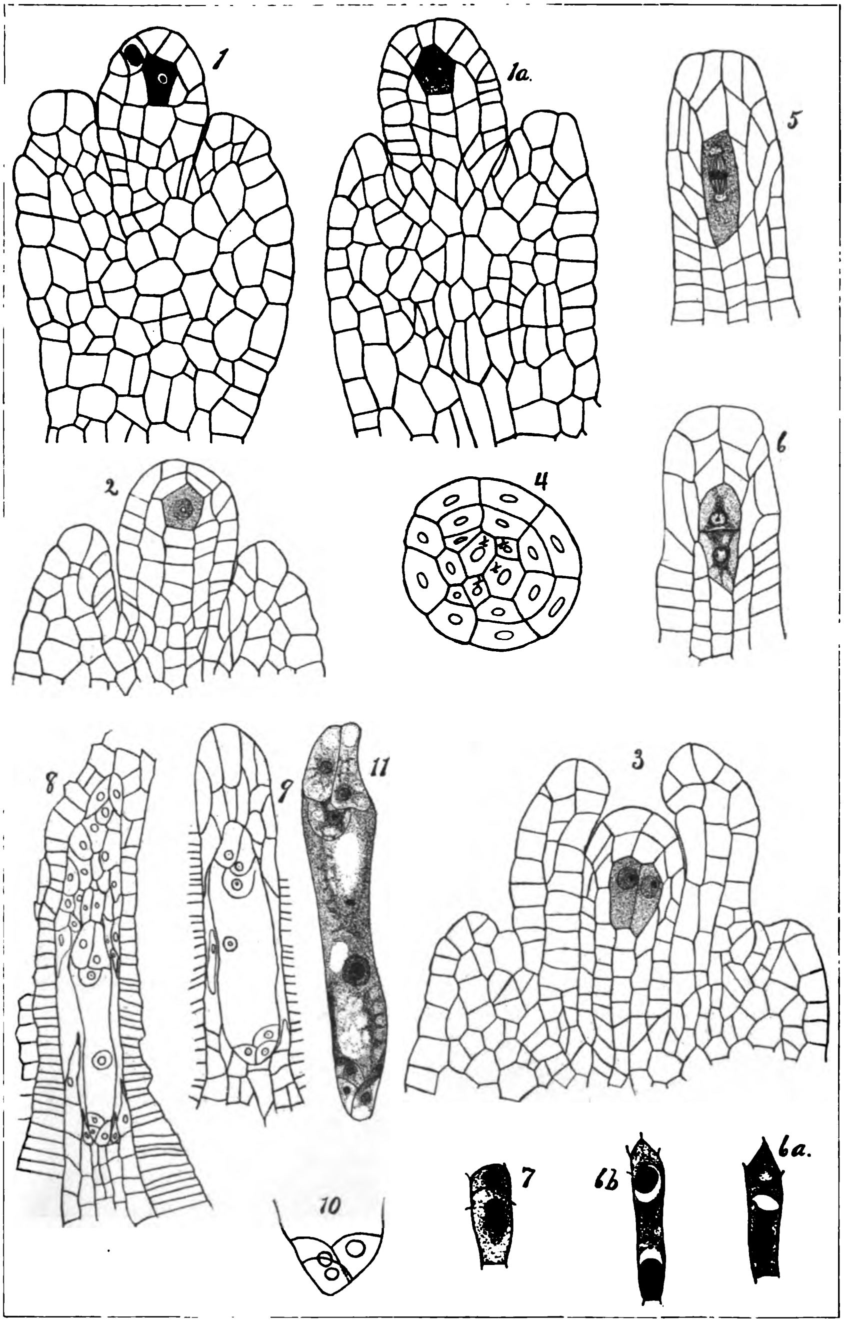
dentate margin has been added; larger, stronger veins have been formed and it is really become a strawberry leaf. Did not this single leaflet, in the sometime of the past, give off the two lateral leaflets, making it trifoliate? Does not fig. 3, give us an affirmative answer to our question? The transition forms (figs. 5, 6, 7,) have followed the same law in the development of these added leaves, which was suggested in the development of the trifoliate from the ancestral type. Descriptions of leaves ordinarily cover but the golden mean. Fig. 4 is the only one which is recognized as having a legitimate place among the leaves of the strawberry. The others are either "poor relations" which should remain in the background, or are too prosperous to remain in the humble household.



VARIATIONS OF THE LEAF OF THE STRAWBERRY.

But the leaves tell their own story so simply and so well that one needs but to give ear unto it in order to understand the progressive steps from the primitive leaf up to the possibilities of the future represented by fig. 8.—MRS. W. A. KELLERMAN, *Columbus, Ohio.*

On the development of the embryo-sac of Arisæma triphyllum. (WITH PLATE XVIII.)—The origin of the angiosperms and the true relationship between monocotyledons and dicotyledons are among the problems now demanding the attention of the botanists. From our present knowledge the monocotyledons may be regarded as the more primitive group from which the dicotyledons have been derived, or the dicotyledons may be looked upon as the primitive group, and the monocotyledons as degenerate forms derived from them. It seems highly probable, however, that one or the other is the correct view;



MOTTIER on ARISÆMA.

for in every representative of both groups, as far as is known to the writer, there is to be found the typical seven-celled embryo-sac, and it is hardly possible that such a structure could have arisen independently in both groups. If in any representative of either of these two groups of plants an embryo-sac should be found varying considerably, or even a little from the type, something toward a solution of the problem would at least be suggested. It is perhaps, among the lower forms that we are to seek such variations, if there are any. With this in view work was begun upon the development of the embryo-sac in Arisæma triphyllum. Although no variation from the common type in the structure of the mature embryo-sac was found, yet a few details in the process of development from the initial cell seem worth mentioning

The initial cell (mother cell) of the embryo-sac arises as a single hypodermal cell in the apex of the nucellus (figs. 1, 1*a*). This cell is well defined as soon as the first traces of the inner integument of the ovule is perceptible, or even sooner. All the cells now increase in size, and those of the epidermis divide by periclinal walls (fig. 2). The initial cell next divides by longitudinal walls into three or four cells two of which may be seen in longitudinal section (fig. 3). A transverse section at this stage of development shows four cells (x) which in all probability were derived from the initial cell. As far as is known to the writer, the longitudinal division of the initial cell of the embryo-sac has been observed and recorded only by Strasburger.[1] This author calls attention to a very unusual state of things in Rosa livida, where about four cells of similar size may be seen in longitudinal section.[2] He also states that he has seen two cells in longitudinal section, but he does not say in what plant or plants it was observed. One of these cells now enlarges considerably (fig. 5), and divides by a cross wall into two cells (fig. 6), the lower one being usually larger than the upper. The lower now absorbs the upper (fig. 7), and develops in the usual manner into the embryo-sac (fig. 11). (The intervening steps in the process are omitted here since they correspond to those of the type.) In the instance represented in fig. 6 the cross wall is only slightly swollen. In but one instance was the cross wall found to be greatly swollen (fig. 6*a*); in all other cases it was always of a more delicate structure, but not appreciably swollen. One instance was observed where there was no cross wall formed, the cell being slightly elongated with a large nucleus in each end and each nucleus accompanied by a vacuole as shown in fig. 6*b*. This, however, must be of very rare occurrence, for in the large number of successful preparations made at this point in the de-

[1] Die Angiospermen und die Gymnospermen, p. 14. 1879.

[2] l.c. p. 14, taf. IV, fig. 50.

velopment, either the nucleus was found in some stage of division, or a distinct wall was present.

During the development following the stage shown in fig. 7, the tissue of the nucellus surrounding the developing sac laterally is rapidly disorganized and absorbed, so that when the embryo-sac is mature, only the apical portion and a few plerome elements of the nucellus, together with the remains of a few disorganizing cells are to be seen. Embryo-sacs in ovules near the wall of the ovary are more elongated (fig. 8) than those of centrally placed ovules (fig. 9). This is due, of course, to pressure against the wall of the ovary mainly.

The position of the antipodal cells varies here as in almost all plants. In some cases all three appeared to lie side by side, others as shown in fig. 10.

It gives me great pleasure to express my sincere thanks to Dr. Douglas H. Campbell, of the Leland Stanford University, for numerous suggestions given me in this work.—DAVID M. MOTTIER, *Indiana University, Bloomington.*

EXPLANATION OF PLATE XVIII.—Figs. 1–3, longitudinal sections of the upper part of young ovules; 1 and 1*a*, × 206; 2, × 196; 3, × 236. Fig 4, transverse section of a nucellus at the point of growth shown in fig. 3; *x* are cells derived from the initial cell, × 310. Fig. 5, longitudinal section ofthe nucellus, the nucleus of the embryo-sac, mother cell in process of division, × 236. Fig. 6, similar to 5; the devision has been completed, × 206. Fig. 6*a*, similar to the shaded part of fig. 6 with the cross wall much swollen, × 236. Fig. 6*b*, similar to 6 with no cross wall. Fig. 7, the lower cell has become large through growth, × 236. Fig. 8, and 9, embryo-sacs with nucellus and portion of integument cells, × 136. Fig. 10, antipodal cells of embryo-sac, × 236. Fig. 11, embryo-sac of 8, × 236.

EDITORIAL.

OUR READERS will, perhaps, remember that two years ago (July, 1890) we mentioned the undertaking of the Commissioner of Education to report the condition of biological instruction in the colleges of this country. That report, long-looked-for-come-at-last, is somewhat disappointing. It is probable that the compiler, Dr. John P. Campbell, is not to be blamed for the tardiness of its publication. But the delay in the Government Printing Office has robbed it of much of its value, for the conditions have had time to change materially since the 1889–90 catalogues, on which it is based, were issued, and we know that, in some institutions, they have been changed much for the better. For the lack of digested and tabulated information, however,

we suppose the compiler *is* responsible. A hundred pages are devoted to a detailed account of the courses in botany and zoology offered in 112 colleges. Finding difficulty in tabulating these facts, because of the large amount of electives in the better colleges, the compiler selects forty-five of those in which the courses are prescribed, makes his tables and draws his deductions largely from them! These forty-five include such as Amity, Georgetown, Iowa, Illinois, Lenox, Moore's Hill, Parsons, Scio, and Simpson colleges, and Lombard and Union universities, to rank among which Amherst, Dartmouth, Lafayette and Princeton must feel proud!

DIFFICULT AS such tabulation might be, it was in *comparisons* that the value of the report might be expected to lie. What courses are required for entrance, what courses are required before graduation, what definite courses are open to the student, and what facilities are possessed, both in the way of men and apparatus for giving these courses, ought to be clearly set forth. Had this information been put in easily available form, we might hope that those prominent institutions which are so wofully remiss in offering instruction in botany and zoology would be brought to a realizing sense of their shortcomings, and be thereby forced to a reformation. But in the chapters which discuss the school and college courses, we have only generalities. We need something more specific than a statement that "a large proportion of our colleges are really doing little more than school work in science. . . The average graduate from such a college is not prepared to conduct the simplest school course in botany." What boots it to say that "out of 111 colleges there are but forty-one in which the biological departments are in the hands of men who have no other teaching?" We want not only to know that, but which the forty-one are, and of those, which have separate professors of botany and of zoology. Why tell us that "there are not more than five or six institutions in the country that furnish students with the means of performing even the simplest experiment in either animal or vegetable physiology" if we have to look through 100 pages to find out which they are?

We recognize the difficulties in the way of presenting a bird's eye view of complicated facts; but it is far from impossible. We could have spared the quotations from various gentlemen about the value of biological training, etc., as well as the history of early biological investigations, far better than we can spare the proper digesting of the facts.

DR. CAMPBELL is, we think, inclined to ascribe too much influence to Johns Hopkins University when, speaking of it as a trainer of

teachers, he says: "Botany has, perhaps, been more influenced than zoology, as is evidenced by the fact that laboratory work is much more general than formerly, and, further, that courses in cryptogamic and physiological botany are now given in colleges where attention was formerly limited to flowering plants." Just how an institution, in which biology is a *nom de guerre* for zoology, has been so efficient in improving the instruction in botany, is not apparent, and the few institutions in which botany, not to specify cryptogamic and physiological botany, is taught, have *not* been supplied from Johns Hopkins.

CURRENT LITERATURE.

A monograph of the Fontinalaceæ.[1]

We are glad to note the publication of this work, in which M. Jules Cardot endeavors to clear up the perplexing forms of our water mosses. The contribution is all the more welcome because the group is one which has its home in our own country, for of the forty-three species of the family, no less than thirty occur in North America, of which twenty-one are endemic.

M. Cardot recognizes six genera, arranged in two tribes. The Fontinaleæ include Hydropogon, Cryptangium, Fontinalis and Wardia; the Dichelymeæ include Brachelyma and Dichelyma. The genus Fontinalis of course contains the bulk of the species. The other three of the first tribe are monotypic, Hydropogon and Cryptangium coming from tropical America, while Wardia belongs at the Cape of Good Hope. Brachelyma is revived to receive our Dichelyma subulatum, while Dichelyma consists of four species.

A notable feature of the monograph is the mode of indicating the rank of the species. They are designated as of four orders. Those of the first order have the greatest assemblage of characters by which they can be discriminated, those of the second order have a smaller assemblage of such characters, and so on. Fontinalis Neo-Mexicana, for example, is a specics of the third order, being much more poorly marked than F. antipyretica of the first order. This does away with subspecies and is much more satisfactory. Varieties are recognized as subordinate forms under species of any rank.

The full citation of synonymy, exsiccati, and geographical distribution, and the extended descriptions and remarks all combine to form

[1] CARDOT, JULES.—Monographie des Fontinalacées. Extrait des Mémoires de la Société nationale des Sciences nat. et math. de Cherbourg, tome XXVIII. 1892. 8vo, pp. 152. Separates 6 fr. 50.

a most excellent piece of work, which is made thoroughly available by a good index. A few separates only have been printed which can be procured of the author at Stenay, France. (See also this journal, *ante*, p. 31.)

Botanical micro-technique.

The constant advance which is now making in the investigation of plant structures demands frequent revisions of the books dealing with the methods of such investigations, and gives opportunity for the making of new ones. Strasburger very successfully combined a laboratory manual with an exposition of technique, a plan which has its disadvantages. Dr. Zimmermann, privat-docent in the University of Tübingen, has produced a book dealing wholly with technique[1], in which he bas brought together the most approved and modern methods of preparing, imbedding, cutting, staining and mounting histological material.

The first section gives an account of the general methods of research; the second describes the organic and inorganic compounds occurring in plants and the reactions by which they can be detected; while the third gives an account of the special methods applicable to the investigation of cell walls in their various modifications and to the protoplasmic cell contents and inclusions. There is some overlapping in these sections naturally, but probably as little as could be expected between any divisions of the subject. A very short appendix mentions some special methods applicable to the examination of bacteria. The study of these organisms has become so much of a specialty and has such an amount of technique that the author wisely leaves this field to others.

The work before us is more complete than those of Poulsen and of Behrens, its two predecessors. If it is inadequate anywhere it is in the paragraphs on the methods of imbedding and section cutting. The arrangement and full index render it exceedingly easy of reference, which in so far enhances its practical value.

Spite of the fact that it would too soon be out of date, it would be well to have it translated into English. It could certainly be made far superior to the cumbersome and costly American edition of Behrens' Guide, and it is much more exhaustive than Trelease's Poulsen, which is almost the only book in English now available.

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[1] **ZIMMERMANN, A.—Die botanische Mikrotechnik; ein Handbuch der mikroskopischen Präparations-, Reaktions- und Tinktionsmethoden. 8vo. pp. x, 278. figs. 63. Tübingen: H. Laupp'schen Buchhandlung. 1892. M. 6.**

Minor Notices.

BULLETIN 38 of the Cornell Experiment Station[1] is devoted to an account of the cultivated native plums and cherries, by Prof. L. H. Bailey. The thorough treatment of the subject and the admirable illustrations keep this bulletin fully up to the rank of its predecessors. Ninety-five varieties are referred to their botanical sources, while forty-four remain still uncertain to the author, being known only from literature or the descriptions of correspondents. From this paper it appears that we have the following native species in cultivation: *Prunus Americana* Marsh., with 45 varieties; *P. hortulana* Bailey and its var. *Mineri*, with 27; *P. angustifolia* Marsh. (*P. Chicasa* Mx.), with 18; and *P. maritima* Wang. with 1. The value of *P. subcordata*, the wild plum of the Pacific coast is yet to be determined. The cherries are treated in a similar manner, but more briefly, since few of the natives have been extensively cultivated. There is an attempt to unravel the tangle regarding *Prunus pumila* of Linnæus and its eastern and western forms, which Prof. Bailey thinks distinct.

TEACHERS in both country and city schools (and in many colleges too) will find the "Elementary Botanical Exercises" recently issued by Dr. Charles E. Bessey[2] most suggestive and helpful. It will help those who would like to see their pupils at some more fruitful work than the memorizing of descriptive terms and the "practice of a few diagnoses." The keys to the lower plants near the end will be specially useful to those who find themselves helpless as far as ordinary text-books are concerned when any but flowering plants are studied. The key-note of the booklet is struck in these sentences from the first pages:

"Botany is *not a book;* much more is it *not a little book.*" "Botany is the study of plants, not the study of books. It is making the personal acquaintance of the structure, reproduction, habits, uses and relationships of plants; not a study about plants. When the inquisitive boy digs up his mother's flower seeds in order to see how they grow, that is botany in the scientific sense; but when he memorizes a chapter on 'germination' in a text-book, that is not botany at all."

PROF. MOSES CRAIG, the botanist of the Oregon Experiment Station, has prepared a bulletin on "Some Oregon weeds and how to destroy them." There are brief descriptions of about thirty weeds, accompanied by wretched illustrations, with directions for destroying each that any body of sense would know. Beyond compliance with the absurd law which requires stations to issue a certain number of bulletins each year, we fail to see the value of such publication.

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[1] pp. 73. 8vo. June 1892.

[2] Published by J. H. Miller, Lincoln, Neb., 1892, 12mo. pp. 50. 35 cents.

IN THE report of the Michigan Horticultural Society for 1891, Mr. A. A. Crozier gathers a host of opinions relating to the mutual influence of the stock and graft. The literature quoted bears on the various phases of the subject, such as change in habit, earliness, character of the fruit, disease, variegation, hardiness, etc. While the testimony is often conflicting and some of it doubtless untrustworthy, Mr. Crozier has done well in collecting what has been written on the matter, as the first step towards his experimental study, which we trust will shed more light on this interesting topic.

DR. ROLAND THAXTER publishes in the *Proceedings* of the American Academy of Arts and Sciences a paper which "includes the additions which have been made during the season of 1891 to the previously recorded species of North American Laboulbeniaceæ, a small number only of new forms being reserved for later description for lack of sufficient material. Three new genera are represented,—Ceratomyces by two species, Corethromyces and Acanthomyces each by a single species. The genus Heimatomyces, formerly including a single European form, contributes ten species, nine of them new; while, lastly, the genus Laboulbenia adds sixteen species, thirteen of which are undescribed. In all thirty species, by which the sum total of American forms is increased to forty-nine. . . . The contribution of aquatic forms is of especial interest, the genus Ceratomyces forming a distinct departure from previously described generic types." The descriptions are full, but without figures.

AS A BULLETIN of the Agricultural Experiment Station of Tennessee, Prof. F. Lamson-Scribner has issued the first part of a manual of the grasses of Tennessee.[1] "This first part is designed for the farmers and agricultural students of the state; affording the former a handy reference book for general information as to the general character and quality of our grasses, and giving the latter a concise account of the characters of the grass family, together with a key for determining the tribes and genera into which the species are classified." There is included in this part an alphabetical list of the native and introduced or cultivated grasses of the state; a series of illustrations, with descriptions thereof, for affording explanation of the technical terms; characters of the grass family, with a key to genera; and, lastly, a list of the books and pamphlets on this group accessible at the station. "In part two it is proposed to fully describe, and, so far as possible, illustrate all of the grasses of the state. Part one is introductory to this."

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[1] LAMSON-SCRIBNER, F.—The grasses of Tennessee. Bulletin of Agric. Exp. Station of the Univ. of Tenn., vol. v., no. 2. 8vo. pp. 30–113. Apr., 1892.

THE GEOGRAPHICAL distribution of the liverworts of northern Norway is comparatively little known. To aid in the elucidation of this subject, Dr. H. Wilh. Arnell undertook extensive journeys through that region in the summer of 1891. He has brought together the results of his studies and examination of literature in a quarto pamphlet, under the title "Lebermoosstudien im nordlichen Norwegen," giving an account of the vertical and superficial distribution of 115 species. It may be obtained of the author at Jönköping.

PROF. J. G. LEMMON, of Oakland, California, has published a "handbook of West-American cone-bearers." It contains brief popular descriptions, and also attempts to establish approved English names. In the great confusion of names in local use the attempt deserves success, and no one is better fitted to speak of Pacific forests than Professor Lemmon.

PROFESSOR L. H. BAILEY has published an excellent paper on cross-breeding and hybridizing.[1] The philosophy of the crossing of plants is considered with reference to their improvement under cultivation, and a brief bibliography of the subject is given. The paper was originally given as a lecture before the Massachusetts State Board of Agriculture.

DR. C. HART MERRIAM has published a list of the plants of the Pribilof or Seal Islands[2] (Bering Sea), based upon specimens collected from July 28 to August 10, 1891. The collection contains about 1000 specimens, representing over 130 species. This is far the largest collection that has been made, or reported from these islands. There is not a tree or bush on the islands, the highest woody plant being the dwarf Salix reticulata. Some critical notes are furnished by Mr. J. N. Rose, and various groups have been referred to well-known specialists.

NOTES AND NEWS.

MR. THEO. HOLM has resigned his position in the National Museum and accepted a place in the Division of Vegetable Pathology.

THE SUMMER course for the study of shrubs and trees at the Arnold Arboretum proved highly successful. About thirty persons were in attendance.

PROFESSOR DR. ALEXANDER BATALIN has been appointed Director of the Imperial Botanic Gardens at St. Petersburg in succession to the late Dr. E. Regel.

[1] The Rural Library, vol. I, no. 6, April, 1892.

[2] Proc. Biol. Soc. of Washington, VIII, 133-150, July, 1892.

THE CHEMICAL COMPOSITION of the pollen of Pinus sylvestris has been investigated by K. Kresling (*Archiv. Pharm.*), and is found to be wonderfully complex. Some thirty or forty complex compounds are listed, and their interpretation is at present out of question.

THE APPROPRIATION for special botanical work in the Botanical Division of the Department of Agriculture has been reduced from $40,000 to $25,000. This is unfortunate in view of the fact that the division had begun a systematic exploration of our least known regions, and the results of the next few years promised to be very great.

A PROPOS of the reference to the great number of novelties among the hepatics described by Colenso (this journal, p. 219, *ante*) should be mentioned a paper by Stephani in the Journal of the Linnean Society, no. 201. After examination of the authentic specimens of 149 species sent to Kew by Colenso, Mr. Stephani concludes that 22 are good species, while 117 are reduced to synonyms!

TWO IMPORTANT contributions to our knowledge of buds have recently appeared; one, by Dr. J. Grüss, in Pringsheim's *Jahrbücher für wissenschaftliche Botanik* XXIII. pp. 637–703; the other by W. Russell in the *Annales des Sciences Naturelles* (botanique) VII. xv. pp. 95—202. Dr. Grüss treats chiefly the anatomy, development, functions and adaptations of the scales of winter buds of trees; Mr. Russell discusses the origin and development of multiple growing points. The latter concludes that the law of the unity of the axillary bud has no exceptions. The accessory buds arise later from the single axillary growing point.

A NOMENCLATOR BRYOLOGICUS, after the plan of Steudel's *Nomenclator botanicus* with the addition of bibliographical references, was undertaken in 1864 by M. le général Paris, at the suggestion of his friend, Dr. W. P. Schimper. For various reasons the work was delayed. He now proposes to take up this work again, and appeals to bryologists to send copies of their papers containing descriptions of new species, or at least references to the place of publication that he may consult them. The work will be of great value to bryologists, and it is to be hoped that it will be vigorously prosecuted and published within a reasonable time. The author may be addressed at Rennes, France.

DRS. ASCHERSON, Engler, Schumann and Urban, of Berlin, seeing the necessity of some modification of the laws of botanical nomenclature formulated in 1867, in order to prevent the confusion likely to be caused by Kuntze's Revisio generum, have proposed the following amendments, which refer only to genera:

"I. The starting point of the priority of the genera, as well as the species, is the year 1752, resp. 1753.

"II. Nomina nuda and seminuda are to be rejected. Pictures alone, without diagnoses, do not claim any priority of a genus.

"III. Similar names are to be conserved, if they differ by ever so little in the last syllable; if they only differ in the mode of spelling the newer one must fall.

"IV. The names of the following larger or universally known genera are to be conserved, though, after the strictest rules of priority, they must be rejected; in many of them the change of the names now used is by no means sufficiently proved."

Regarding the last, they remark:

"The impulse that led to the acknowledgement of the right of priority was only the vivid desire to create a stable nomenclature. If we see that by the absolute and unlimited observance of the principle we probably gain the contrary of what we intended, we, who have ourselves made the rules of priority as a law, have the right to amend the latter." They, therefore, propose to retain seventy-eight genera, embracing nearly 5000 species, in spite of the fact that there are possibly equivalent earlier names. A circular letter containing these proposals is being sent to botanists engaged in descriptive work, with a request that they indicate their adherence to those propositions, or suggest any modifications they desire.

MR. SPENCER LEM. MOORE, in a supplementary paper[1] to the one noticed in this journal, *ante*, p. 102, corrects some of the statements made therein. His conclusion that the callus which closes the sieve plates of the vegetable marrow was of proteid nature, was due to working with abnormal material. "Some of the plates are obliterated by true callus, which neither gives proteid reactions nor peptonizes; others, at the end of the season, are blocked by the proteid body described in the former memoir." For the latter substance he proposes the name "paracallus."

He has also studied the reactions of the cell walls, which are supposed to show that these have enclosed proteid matters in the course of their growth. He concludes that these reactions are not due to proteids, at least not to peptonizing proteids, but probably depend upon glucosides, a point which can sometimes be proved. He suggests that "the presence of glucoside in lignified cell walls may possibly give to them their property of conducting fluid, *à propos* of Haberlandt's discovery of a glucoside as the osmotically active substance in Mimosa pudica."

[1] Journal of the Linnean Society, XXIX, p. 231.

BOTANICAL GAZETTE

SEPTEMBER, 1892.

Flowers and insects. IX.

CHARLES ROBERTSON.

HYDRANGEA ARBORESCENS L.[1]—The stems rise from one to several feet high and bear flat-topped compound cymes measuring seven to ten centimeters across. Each cyme is commonly surrounded by a few large sterile flowers which render it much more conspicuous. These sterile flowers are remarkably persistent, retaining their form throughout the winter, though they lose their color.

The entire fertile flower with its pedicel is white. The petals are small and soon fall. The stamens, which are commonly ten, with their large anthers, are the most conspicuous part of the flower. When dehiscent they far overtop the stigmas. Nectar is secreted on the base of the styles, though pollen is the chief attraction.

The flowers are homogamous, but are visited by so many bees and flies that frequent cross-pollination is inevitable. Insects may also effect self-pollination, or spontaneous self-pollination may occur by the pollen falling upon the stigmas.

The plants are common on creek banks and were observed in bloom from June 24th to July 23rd. The following list of visitors was observed June 27th and 30th:

Hymenoptera—*Apidæ:* (1) Bombus separatus Cr. ☿, c. p., ab.; (2) B. americanorum F. ♀, c. p.; (3) Ceratina dupla Say ♀, s. and c. p.; (4) Heriades carinatum Cr. ♀, c. p.; *Andrenidæ:* (5) Augochlora labrosa Say ♀, s. and c. p.; (6) Halictus pectoralis Sm. ♂♀, s. and c. p.; (7) H. similis Sm. ♀, s. and c. p.; (8) H. truncatus Rob. (MS.) ♀, s. and c. p.; (9) H. fasciatus Nyl. ♀, c. p.; (10) H. confusus Sm. ♀, s. and c. p., ab.; (11) H. stultus Cr. ♀, s. and c. p., ab.; (12) Prosopis affinis Sm. ♂♀, s. and f. p., ab.; *Crabronidæ:* (13) Crabro interruptus Lep., s.

[1]See Meehan: Contributions to the life histories of plants, No. II, Proc. Acad. Nat. Sci., Phil., 1888.

Diptera—*Empidæ:* (14) Empis clausa Rob. (MS.) s., ab.; *Conopidæ:* (15) Oncomyia loraria Lw., s., freq.; (16) Stylogaster biannulata Say, s.; *Syrphidæ:* (17) Paragus tibialis Fll., s. and f. p.; (18) Syrphus americanus Wd., s. and f. p.; (19) Allograpta obliqua Say, s. and f. p.; (20) Mesograpta geminata Say, s. and f. p.; (21) Sphaerophoria cylindrica Say, s. and f. p.; (22) Eristalis tenax L., s.; (23) Syritta pipiens L., s. and f. p.; *Tachinidæ:* (24) Jurinia apicifera Wlk., s.; *Muscidæ:* (25) Graphomyia sp., s.; (26) Musca domestica L., s.; (27) Lucilia cornicina F., s.

Coleoptera—*Cerambycidæ:* (28) Euderces picipes F., s. and f. p.; (29) Typocerus velutinus Oliv., s. and f. p.; *Mordellidæ:* (30) Mordella marginata Melsh., s., ab.; (31) Mordellistena sp., s., ab.; (32) M. ornata Melsh.

Lepidoptera—*Hesperidæ:* (33) Eudamus tityrus F., s.; *Pyromorphidae:* (34) Harrisina americana Harr., s. (determined by Prof. G. H. French).

PHILADELPHUS GRANDIFLORUS Willd.[2]—This plant occurs in my neighborhood only in cultivation. I have found it visited very abundantly by *Heriades philadelphi* Rob. ♂♀.

RIBES GRACILE Michx.—The Missouri gooseberry is common in woods, blooming from April 15th to May 3d. The bushes are sometimes collected in large clumps, the flowers being abundant enough to fully repay the attention of insects.

The greenish flowers grow in axillary clusters of two or three. The pendulous position and the characters of the flower indicate an adaptation to bees. The calyx tube is two or three mm. long. The oblong lobes, which measure six or seven mm. in length, are strongly reflexed. With the petals they form footholds for the bees to cling to, and with their purplish bases, are the most conspicuous parts of the flower. The five stamens are exserted 12 mm. or more beyond the calyx-tube, and are closely approximated. Five pinkish petals about 2 mm. long are pressed against the filaments, closing as far as they go the intervals between them.

The flowers are proterandrous. When receptive, the stigma surpasses the anthers a little. The anthers sometimes retain pollen after the stigma becomes receptive, but self-pollination is hardly possible, unless it is brought about by insect aid. Everything points to cross-pollination between separate flowers.

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[2]On P. coronarius see Müller: Fertilization of Flowers, 248.

The nectar is secreted by an epigynous disk and is held in place by the abundant hairs on the base of the style and on the wall of the calyx-tube. To reach it bees must insert their proboscides between the filaments beyond the tips of the petals. For this purpose a proboscis at least 4 mm. long seems to be needed.

The flowers are especially adapted to bumblebee females, the only sex of Bombus flying while the flowers are in bloom. These bees are the only ones which, while sucking, invariably touch the anthers and stigmas. They cling to the petals and sepals, and the anthers and stigmas strike them about the base of the ventral surface of the abdomen. Of these the following were noted visiting the flowers for nectar:

(1) Bombus separatus Cr. ♀; (2) B. vagans Sm. ♀; (3) B. virginicus Oliv. ♀, ab.; (4) B. americanorum F. ♀, very ab.

Besides bumblebees there occur as frequent visitors a number of species of bees which insert their proboscides between the filaments and are able to reach the nectar, but are so small that they never, or rarely, touch the anthers and stigmas, and so are to be regarded as mere intruders. Such are:

Apidæ: (1) Apis mellifica L. ☿, s. and c. p., ab.; (2) Osmia albiventris Cr. ♂, s.; (3) O. lignaria Say ♂, s.; (4) Nomada luteola Lep. ♂♀, s.; *Andrenidæ:* (5) Agapostemon radiatus Say ♀, s.; (6) Augochlora pura Say ♀, s.; (7) A. lucidula Sm. ♀, s.; (8) Andrena sayi Rob. ♂♀, s., ab.; (9) A. pruni Rob. ♂♀, s.; (10) A. rugosa Rob. ♂, s.; (11) Halictus gracilis Rob. ♀, f. p., ab.; (12) H. coriaceus Sm. ♀, s.; (13) H. lerouxii Lep. ♀, s. and f. p.; (14) H. cressonii Rob. ♀; (15) H. zephyrus Sm. ♀; (16) H. imitatus Sm. ♀; (17) H. stultus Cr. ♀; (18) Colletes inaequalis Say ♂♀, s.

Diptera—*Empidæ:* (19) Empis sp., s.

The visitors were observed on nine days between April 18th and 29th.

LUDWIGIA ALTERNIFOLIA L.—The yellow flowers are rather conspicuous. Honey collects in round drops in four pits on the sides of the ovary between the bases of the filaments. The pits are slightly protected above by a fringe of hairs. Some of the anthers dehisce when fairly in contact with the stigma, but much of the stigma remains clear, and so can receive pollen brought by insects. *Bombus americanorum* F. ☿, was seen visiting the flowers for nectar, and *Halictus stultus* Cr. ♀, visiting them for pollen. The flowers were seen in bloom from July 19th to Aug. 10th.

LUDWIGIA POLYCARPA S. & P.—The flowers are wholly devoid of entomophilous characters. The petals are wanting, and there is no nectar. The four stamens bend inwards, bringing the anthers in contact with the stigma. Spontaneous self-pollination is therefore a regular occurrence.

ŒNOTHERA BIENNIS L.[3]—The following list was observed on Aug. 26th and 29th:

Apidæ: (1) Bombus americanorum F. ♂ ☿, s. and c. p., freq.; (2) Melissodes bimaculata Lep. ♀, c. p.; (3) M. obliqua Say ♀, c. p.

Trochilidæ: (4) Trochilus colubris L., s., two.

I have found the flowers in bloom from July 22nd to Oct. 15th.

Müller found it visited by one Macroglossa, three Bombus, one Apis, one Colletes, one Panurgus, three Eristalis.

ŒNOTHERA FRUTICOSA L.—This is a common plant, growing on prairies. The stem rises a few dm. and generally bears one, sometimes two or three, yellow flowers which expand 4 or 5 cm. Eight large versatile anthers supply pollen, which is an attractive character of the flower. The stigma surpasses the anthers so that self-pollination is impossible without insect aid. As a rule, the stigma is inclined to the lower side in such a position that it readily strikes the ventral surface of a bumble-bee settling upon the flower. If insects come with pollen, they may effect cross-pollination, otherwise they may effect self-pollination. When two or more flowers are expanded at the same time cross-pollination between flowers of the same plant may occur. In the usual case in which the stem exposes only one open flower at a time cross-pollination between distinct plants is the rule.

The tube measures 14–20 mm., so that it can only be drained by the largest bees, but shorter-tongued bees are sometimes able to reach a little of the nectar which rises in the tube.

Besides the long-tongued insects which visit the flower for nectar, there are many species, especially Andrenidae and Syrphidae, which come only for pollen. Accordingly the flower must be regarded as adapted to both sets of insects.

The flowers bloom from May 24th to June 29th. On 7 days, between May 28th and June 19th, the following list was observed:

[3]See Müller: Fertilization of Flowers, 246.

Hymenoptera—*Apidæ:* (1) Bombus americanorum F. ♀, s. and c. p., ab.; (2) Synhalonia speciosa Cr. ♀, s. and c. p.; (3) Ceratina dupla Say ♀, c. p.; (4) Megachile brevis Say ♂♀, s.; (5) M. montivaga Cr. ♂♀, s. and c. p., ab.; (6) Alcidamea producta Cr. ♀, c. p.; *Andrenidæ:* (7) Agapostemon nigricornis F. ♀, c. p., ab.; (8) Augochlora pura Say ♀, c. p., freq.; (9) Halictus pectoralis Sm. ♀, c. p.; (10) H. parallelus Say ♀, c. p.; (11) H. lerouxii Lep. ♀, c. p.; (12) H. ligatus Say ♀, c. p.; (13) H. fasciatus Nyl. ♀, c. p.; (14) H. albipennis Rob. ♀, c. p.; (15) H. confusus Sm. ♀, c. p.

Diptera—*Syrphidæ:* (16) Syrphus americanus Wd., f. p.; (17) Sphaerophoria cylindrica Say, f. p.; (18) Eristalis dimidiatus Wd., f. p.; (19) E. latifrons Lw., f. p.; (20) Tropidia mamillata Lw., f. p.; *Tachinidæ:* (21) Cistogaster pallasii Twns., f. p.

Lepidoptera—*Rhopalocera:* (22) Pieris protodice B.-L.; (23) Pamphila peckius Kby.; (24) P. cernes B.-L.—all s.

Coleoptera—*Chrysomelidæ:* (25) Diabrotica 12-punctata Oliv., f. p.; *Curculionidæ:* (26) Centrinus scutellum album Say, f. p., ab.

GAURA BIENNIS L.[4]—This common species was observed in bloom from August 4th to October 24th. The stems grow one or two metres high, bear numerous flowers, and are often collected in large patches.

The flowers are white. The four petals are all turned to the upper side of the flower, and the stamens, which are directed horizontally, afford a landing place to the visiting insects. The stigma is in advance of the anthers and touches the bee before them. The calyx tube is about 10 mm. long. The flowers are adapted to long-tongued bees, but on account of the exposure of the anthers are also visited for pollen by other insects. The list was observed on 5 days, between Aug. 23d and Sept. 10th.

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, c. p.; (2) Bombus americanorum F. ☿, s. and c. p., ab.; (3) B. virginicus Oliv. ☿, c. p.; (4) Melissodes bimaculata Lep. ♀, s. and c. p.; *Andrenidæ:* (5) Halictus confusus Sm. ♀, c. p.

Diptera—*Syrphidæ:* (6) Syrphus americanus Wd., f. p.

CIRCÆA LUTETIANA L.—The flower is described and figured by Müller in the Fertilization of Flowers, 265. Müller saw

[4] See Sprengel; 223, Pl. XIII, 12, 14, 15. See G. Lindheimeri, Goodale & Sprague: Wild flowers, Pl. XXIII.

the flowers visited by: *Syrphidæ:* (1) Baccha elongata F.; (2) Ascia podagrica F.; (3) Melanostoma mellina L.; *Muscidæ:* (4) Musca domestica L.; (5) Anthomyia sp.

July 2nd, 4th and 10th I saw the flowers visited by:

Hymenoptera—*Andrenidæ* (1) Augochlora pura Say ♀, s. and c. p., freq.; (2) Halictus 4-maculatus Rob. ♂ ♀, s. and c. p., ab.; (3) H. confusus Sm. ♀, s. and c. p.; (4) H. pectinatus Rob. ♀, c. p.; *Chalcididæ:* (5) Spilochalcis debilis Say, s.

Diptera—*Bombylidæ:* (6) sp.; (7) Hemipenthes sinuosa Wd., f. p.; *Syrphidæ:* (8) Allograpta obliqua Say; (9) Mesograpta marginata Say; (10) M. geminata Say—all sucking.

MOLLUGO VERTICILLATA L.[5]—"An immigrant from farther south."—The plants are much branched, the branches lying flat on the ground and bearing small, white flowers, which are numerous but not enough to form conspicuous clusters.

The flowers are erect, expand horizontally and measure about 4 mm. across. The three anthers rise to the level of the three stigmas and alternate with them.

In case of insect visits, cross-pollination between flowers of the same or of distinct plants may readily occur. In case insects fail, spontaneous self-pollination may take place by the anthers coming in contact with the stigmas.

Although the flowers are very inconspicuous, they are attractive to numerous small insects, mainly *Halictus*, on account of their easily accessible nectar.

I have found the plant in bloom from July 1st to Oct. 12th. On three days, July 16th, and Aug. 11th and 21st, the following list of visitors was observed:

Hymenoptera—*Andrenidæ:* (1) Halictus fasciatus Nyl. ♂, s.; (2) H. pilosus Sm. ♂, s.; (3) H. confusus Sm. ♂ ♀, s. and c. p. freq.; (4) H. tegularis Rob. ♂ ♀, s.; (5) H. stultus Cr. ♀, s. and c. p. freq.; *Philanthidæ:* (6) Cerceris finitima Cr., s., freq.

Diptera—*Conopidæ:* (7) Zodion nanellum Lw.; *Syrphidæ:* (8) Paragus tibialis Fll.; (9) Pipiza pulchella Will.; (10) Mesograpta marginata Say; *Sarcophagidæ:* (11) Sarcophaga sp.; *Muscidæ:* (12) Lucilia cornicina F.—all sucking.

Coleopetra—*Malachidæ:* (13) Collops 4-maculatus F., s.

SAMBUCUS CANADENSIS L.—The stems grow three or four meters high, and are commonly collected in clumps, which at blooming time are fairly white with the large flat-topped cymes. The flowers expand 4 or 5 mm. They are homo-

[5]On this plant see Meehan; Torrey Bulletin, XIV, 218.

gamous. The stamens are so strongly divergent that spontaneous self-pollination is impossible. Nectar is wanting, the object of insect visits being the pollen. The plant is common and was observed in bloom from June 15th to July 25th. June 17th, 23d and 24th, the following visitors were noted:

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, freq., (2) Ceratina dupla Say ♀; *Andrenidæ:* (3) Halictus zephyrus Sm. ♀, ab.; (4) H. confusus Sm. ♀, ab.; (5) H. stultus Cr. ♀, ab.—all collecting pollen.

Diptera—*Bombylidæ:* (6) sp.; (7) Hemipenthes sinuosa Wd.; *Syrphidæ:* (8) Chrysogaster nitida Wd., ab.; (9) Syrphus ribesii L., freq.; (10) Allograpta obliqua Say, freq.; (11) Mesograpta marginata Say; (12) Eristalis dimidiatus Wd.; *Muscidæ:* (13) Lucilia cornicina F.; *Anthomyidæ:* (14, 15) Chortophila spp.—all feeding on pollen.

Coleoptera—*Dermestidæ:* (16) Attagenus piceus Oliv.; *Malachidæ:* (17) Anthocomus erichsoni Lec.; *Cerambycidæ:* (18) Euderces picipes F.; *Mordellidæ:* (19) Pentaria trifasciata Melsh.—all feeding on pollen.

HOUSTONIA PURPUREA L., VAR. CALYCOSA Gr.—This common plant grows in tufts or clusters which are rendered quite conspicuous by the abundant white flowers, the stems rising about 2 dm.

The corolla is funnel-form, measuring about 8 mm. in length, its border also expanding about 8 mm. The tube is about 7 mm. Below it is narrowed for about 4 mm. Small bees can insert their heads as far as 3 mm., when they need a proboscis 4 mm. to drain the sweets. The narrow part of the tube is obstructed in both forms by abundant hairs, in the long-styled form by the anthers and in the short-styled form by the stigma. The anthers of the short-styled form are in the angles of the mouth of the tube, the stigma of the long-styled form being more strongly exserted.

The anthers of the long-styled form apply their pollen to the proboscides of the visitors. The anthers of the short-styled form dust their pollen indefinitely upon all parts of the insects. Accordingly the long-styled form has a larger stigma.

The flowers are adapted to small bees, like *Ceratina*, *Calliopsis* and *Halictus*, but are also visited by flies, beetles and butterflies. Butterflies, however, are only adapted to pollinate the short-styled form, since they can suck this form with-

out touching the anthers. A monopoly of the flowers by them would probably result in a functional diœcism, characterized by long-styled staminate and short-styled pistillate flowers.

The plant blooms from May 19th to June 30th. The list was observed on 6 days, between May 25th and June 12th.

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, s.; (2) Synhalonia honesta Cr. ♂, s.; (3) Ceratina dupla Say ♂♀, s. and c. p., ab.; (4) Heriades carinatum Cr. ♂ s.; (5) Calliopsis andreniformis Sm. ♂♀, s. and c. p., ab.; *Andrenidæ:* (6) Augochlora pura Say ♀, s. and c. p.; (7) Halictus ligatus Say, ♀, s.; (8) H. pilosus Sm. ♀, s. and c. p.; (9) H. confusus Sm. ♀, s. and c. p.; (10) H. albipennis Rob. ♀, s. and c. p.

Diptera—*Syrphidæ:* (11) Paragus bicolor F., s.; (12) P. tibialis Fll., s.; (13) Mesograpta marginata Say, s.; (14) Sphaerophoria cylindrica Say, s. and f. p., ab.; (15) Syritta pipiens L., s.

Lepidoptera—*Rhopalocera:* (16) Pieris protodice B.-L.; (17) Chryophanus thoe B.-L.; (18) Ancyloxypha numitor F., ab.; (19) Pholisora catullus F. —all sucking.

Coleoptera—*Scarabæidæ:* (20) Trichius piger F., s., ab.; *Curculionidæ:* (21) Centrinus scutellum-album Say, s.; (22) Stethobaris sp., s.

Carlinville, Ill.

Botanical papers read before Section F, A. A. A. S., Rochester meeting.

N. L. BRITTON: "*Notes on Ranunculus repens and its eastern North American allies.*"—Attention was called to the group relationship that evidently exists between the European R. repens and such American species as *R. hispidus* Mx., *R. fascicularis* Muhl., *R. septentrionalis* Poir., *R. palustris* Ell. (a somewhat doubtful southern species), and the British Columbian *R. Macounii* Britton. Illustrated by specimens.

N. L. BRITTON: "*Notes on a monograph of the North American species of Lespedeza.*"—The author believes that it would facilitate the study of these species to recognize a greater number of species than heretofore, instead of considering some of them forms. Illustrated by numerous specimens.

W. W. ROWLEE: "*The root-system of Mikania scandens.*"—Mikania develops a great number of roots under water which never reach the soil. The greatest development of these is

during and after anthesis, in autumn, when the root-branching is immense. These roots come to the surface and either float or rise above it. If the water rises above them they grow longer. When transplanted to dry conditions the same root-system is developed. The rootlets, however, are not so long, but stop just above the surface of the ground, forming multitudes of little "knees" about an inch or less in height. A peculiar anatomical structure is found in the presence (in section) of four peculiarly modified cells, two of which belong to the endodermis and two to the row of cells just outside. These cells always lie in contact with the phloem cells and are so arranged as to enclose a rectangular intercellular space of considerable size and definite shape. They have large nuclei which are always upon the side of the cell next to the intercellular space. These spaces extend to very near the growing point of the root, thus forming long tubes. This, taken in connection with the peculiar development of the roots and their place of growth, is strong evidence in favor of their performing the function of aeration.

L. M. UNDERWOOD: "*Preliminary comparison of the hepatic flora of boreal and sub-boreal regions.*"—To be published in full in the GAZETTE.

E. F. SMITH: "*On the value of wood-ashes in the treatment of peach-yellows.*"—This well-known treatment had been fully tested, and was found inefficient in all doses. The conclusion was that peach-yellows cannot be cured or prevented by wood-ashes.

E. F. SMITH: "*On the value of superphosphates and muriate of potash in the treatment of peach-yellows.*"—This mixture is that recommended by Profs. Goessmann and Penhallow. It was tested for three years, 1889-1891, and no benefit was discovered. In fact, the treatment seemed rather to favor the disease than otherwise. It was remarked that well-fed plants may become diseased quite as readily as weak plants.

G. MACLOSKIE: "*Notes on maize.*"

W. J. BEAL: "*Spikes of wheat bearing abnormal spikelets.*"—Spikes of Missouri wheat, Champion Amber, Early Red Clawson, and several others, bear spikelets either rudimentary or perfect near those normally appearing. These are much like reduced forms of miracle or Egyptian wheat, in which the spikes are branched. Illustrated by specimens.

W. J. BEAL: "*A study of the relative lengths of the sheaths and internodes of grasses for the purpose of determining to*

what extent this is a reliable specific character."—Some agrostologists use this character and some do not. From 10 to 30 plants in each of 47 species were examined, and the internodes and sheaths measured and tabulated. The character proved good in 35 species. In very variable species it is of less importance, and in no case would it be safe to rely upon one or two stems alone. The sheaths and internodes of very tall specimens or very short ones are usually much less reliable for specific characters than those of medium height. The second and third sheaths and internodes from the top are more reliable for this purpose than the others. Illustrated by seven charts.

W. W. ROWLEE: "*Adaptation of seeds to facilitate germination.*"—The most critical time in the life history of the plant is when the embryo is dormant in the seed. Hence it is to be expected that all modifications of the seed have some explanation in the economy of its existence. Careful observation of the germination of seeds of native plants shows that few seedlings are produced. Fruits of Acer dasycarpum are held upright by the wing when falling in grass or rubbish. Planting seeds below the surface of the ground showed that twice as many seeds grew when planted with radicle down as with radicle up. The paper was followed by an interesting discussion concerning the struggle for existence and the vitality of seeds.

H. L. RUSSELL: "*Bacteriological investigations of marine waters and the sea floor.*"—To be published in full in the GAZETTE.

F. V. COVILLE: "*Sketch of the flora of Death Valley, California.*"—The paper was introduced by a general statement of the topography of Death Valley. The absence of trees was spoken of and the characteristics of other vegetation. Lists of species were arranged by groups, with an account of the special adaptation of species to desert conditions. In conclusion the geographical relationship of the flora was discussed.

J. C. ARTHUR: "*How the application of hot water to seed increases the yield.*"—To be published in full in the GAZETTE.

M. MILES: "*Heredity of acquired characters.*"—Weismann's theory of the continuity of a stable, immortal germplasm that is independent of the body-plasm, and transmitted without change from one generation to another, is not warranted by the known facts of physiology, and it cannot,

therefore, be accepted as proof that acquired characters are not hereditable. The transformations of matter and energy in the metabolic processes of nutrition, in plants and animals, as now interpreted by physiologists, must extend to the growth and development of the germ-cells, which are thus brought into intimate relations with the metabolism of every part of the body. The general course and results of the processes of nutrition are essentially the same in plants and animals. The food constituents, in the first place, are built up into protoplasm, with a storing of energy as an indispensable condition of its constitution; and the various tissues and constituents of the organism, including the germ-cells, are then formed as products of its destructive metabolism, with a liberation of a portion of the stored energy in the form of heat. Established habits of the system, or of particular organs, and changes in the environment including conditions of food-supply, have an influence on the general and special processes of metabolism of the system, in which the germ-cells are involved, and the hereditary transmission of the modified habits of the organism are thus provided for. The non-appearance of any peculiarity of the parent in the next generation cannot be accepted as evidence that it has not been transmitted, as it may be obscured and made latent through the dominant influence of other characters, as in the well known facts of atavism. Morphological characters are not more important factors in evolution than the functional activities and bias of the organism on which they depend for their origin and development. The transmission of a morphological character must consist in a transmitted functional activity of the organism that determines the development of the morphological peculiarity under favorable conditions for its exercise. In addition to these physiological considerations, evidence of the heredity of acquired characters was presented in the results of direct experiment, and observations in the breeding and improvement of domestic animals.

L. H. BAILEY: "*On the supposed correlation of quality in fruits--a study in evolution.*"—It is commonly supposed that as quality in cultivated fruits increases various other characters, as size, color, and vigor of plant, decrease. The question is a philosophical one, for its answer must determine whether cultivated plants are subject to the same laws of variation as their wild congeners, whether all characters vary independently, or whether cultivation introduces some

new law of progression in parallelisms. The subject is approached by a study of the scales of points used in the best fruit-lists, by which it becomes apparent that all desirable qualities often appear in the same variety of fruit, and that many of our best market-fruits are also best for the dessert. The best records show that diminished size, low color, comparative seedlessness, tenderness of tree, and lessened vigor, are not correlated with high flavor. It is also shown that there is no loss of sweetness or aroma in domesticated fruits which is due to cultivation and amelioration. It is evident from the whole discussion that quality and other characters of cultivated fruits appear independently of each other, that there is no correlation between these characters. There is general increase in all characters as amelioration progresses, at least in all characters which are particularly sought by horticulturists; and this fact must ever remain the chief inspiration to man in the amelioration of plants.

H. L. RUSSELL: "*Non-parasitic bacteria in vegetable tissue.*"—Experiments were made by infecting healthy plants with various species of bacteria, saprophytic as well as those that are pathogenic for animals, to see (1) the effect of any of these micro-organisms upon the plant, and (2) the reciprocal effect of the host upon the micro-organism. The conclusions reached were that healthy plant-tissues, like animal tissues, are normally free from bacteria; but that, unlike the animal tissue, many micro-organisms are able not only to exist within the tissues of plants, but possibly possess some powers of multiplication.

W. A. KELLERMAN: "*Note on yellow pitch pine.*"—A well marked form of pitch pine was recently found in Fairfield county, Ohio, which may be characterized as *P. rigida* var. *lutea* Kellerman. It differs in the thinner scarcely furrowed reddish-yellow bark, and in the deeper yellow more durable and more distinctly marked heartwood. It occurs with the species, yet appears quite distinct. The form is easily recognized by sight, and is not a mere lumberman's questionable distinction.

W. A. KELLERMAN: "*Germination at intervals of seed treated with fungicides.*"—Experiments in connection with a study of fungicides for smut of oats have shown that seed treated with hot water and solutions of potassic sulphide germinate more quickly than untreated seed. Dr. Arthur has also shown that such treated seeds would continue to

germinate more quickly after a considerable period of time had elapsed. Experiments touching this were instituted, with the following results: (1) That germination of treated seed is more rapid than of untreated seed immediately after treatment; (2) that this action continuously declines with time and the germination is ultimately less rapid and inferior.

M. B. WAITE: "*The fertilization of pear flowers.*"—A brief general account was given of a large series of experiments on the fertilization of pear flowers. Abundant insect visitors were noted and the effect on them of climatic conditions. The general conclusions were: (1) Some cultivated varieties of pear are capable of self-fertilization, but the majority are not; (2) cross-fertilization is effected by insects; (3) cross-fertilization, at least the kind required for the setting of fruits, consists in crossing one horticultural variety with another, and not in crossing one tree of a certain variety with another of the same name.

C. V. RILEY: "*The fertilization of the fig and caprification.*' —A résumé of the subject of caprification in the older countries was given, showing its importance and necessity in the cultivation of the best Smyrna figs, with a statement of the differences between the Smyrna and Adriatic figs. The author considered the question of the importation of *Blastophaga psenes* for the fig-growers of California, and pointed out how it could be successfully done. He touched on the erroneous notions that have been published on the subject, and finally considered the caprifig insects associated with the wild figs of North America, characterizing some fourteen of them from Florida, Mexico and St. Vincent.

F. B. MAXWELL: "*A comparative study of the roots of Ranunculaceæ.*"—The paper contained the results of the examination of the roots of about thirty species native to the northern United States, including a comparative study of the apical meristem and of the changes taking place through secondary growth. Authorities on meristem structure have assigned the roots of this order to a single type; while the author finds two principal types, each including a considerable number of species. It is usually assumed that secondary changes take place to a greater or less extent in mature roots of dicotyledons; but the author finds in many Ranunculaceæ that the primary structure persists in the older roots. On the basis of changes taking place through secondary growth, the author made three classes for the roots studied.

O. F. COOK: "*Do termites cultivate fungi?*"—In the nests of Liberian species of Termes are found honeycombed masses of a punk-like substance, irregularly rounded in general shape. Over all the surfaces and passages of this material there grows the mycelium of a mucor-like fungus, having white sporangia about 5 mm. in diameter. The young termites apparently feed upon these fungi. A similar condition of things obtains with another species of Termes living underground.

JAMES H. STOLLER: "*The conditions which determine the distribution of bacteria in the water of rivers.*"—In the author's absence the paper was read by title.

WILLIAM P. WILSON: "*Adaptations of plants to environment.*"—A comparison of lowland vegetation near the sea with that of desert and mountain areas. A large number of lantern slides were shown, illustrating the ways in which plants of these regions protect themselves against excessive evaporation, particularly by change in position of foliage. In such leaves the author found no change in the position of the chlorophyll bodies. The stomata in the exposed leaves were closed, while those in shaded leaves were open.

S. A. BEACH: "*Notes on self-pollination of the grape.*"—The author showed that the proper time for examining grape-buds to determine whether self-pollination occurs before the flowers open is just at the time when dehiscence of the calyx begins. Clusters of grapes were enclosed in bags before blossoming to prevent the access of foreign pollen. Self-pollination was observed in seventy-seven individuals, distributed among eight species and their hybrids and crosses.

GEO. B. SUDWORTH: "*The comparative influence of odor and color of flowers in attracting insects.*"—Attention was called to a supposed development from a low to a high grade in the colors of flowers, ranging from "the simplest, yellow; 2nd, white; 3d, pink to red; 4th, the most perfect color, blue." The author spoke of his own experiments and those of others, which seem to prove that nectar-gathering insects of higher order (honey bees, etc.) show a preference for the colored flowers of higher grade. He believes, however, that the comparative attractability of color is less powerful in its influence upon insects than that of odor, his experiments showing, first, that the honey bees work persistently upon syrup scented with an artificial sweet odor (anise), but refuse to take the

same sweet when unscented; and second, that color does not attract insects at all when tested equally with an odor, the supply of sweet to be obtained in connection with the color and odor tests being equal in both cases.

CHAS. W. HARGITT: "*Notes on Daucus Carota.*"—In the author's absence the paper was read by title and will be published in full in the GAZETTE.

FREDERICK V. COVILLE: "*Geographical relationship of the flora of the high Sierra Nevada, California.*"—A list of the representative species of the high Sierra Nevada was given, and also a comparison of these plants with those found in the Rocky Mountains and the Cascades. This comparison indicated (1) a large endemic flora of the Sierra Navada, (2) a group of species common to all these ranges; (3) a group of species common only to the Sierras and Cascades; (4) a group common only to the Sierras and Rockies.

W. M. BEAUCHAMP: "*Variation in native ferns.*"

DAVID G. FAIRCHILD: "*Live-for-ever eradicated by a fungous disease.*"—Attention was drawn to a new species of fungus which since 1887 has been in use among the farmers of Cortland Co., N. Y., in the eradication of a most troublesome weed, (Sedum Telephium). A short history of the successful use of this disease was given, with a brief description of the parasitic fungus which causes the destruction of the plants. Attention was called to a new mode of spore-formation connected with the production of the macrospore of this fungus.

GEORGE VASEY: "*Otto Kuntze's changes in the nomenclature of North American grasses.*"—In the author's absence this paper was read by title.

B. E. FERNOW and GEO. B. SUDWORTH: "*Revised nomenclature of the arborescent flora of the United States.*—"The paper points out the practical bearing and importance of the question of nomenclature, and suggests certain principles intended to secure fixity.

C. V. RILEY: "*On Carphoxera ptelearia, the new herbarium pest.*"—In the author's absence the paper was read by title.

FREDERICK V. COVILLE: "*Characteristics and adaptations of desert vegetation.*"—The author spoke of the source and distribution of moisture, its conservation, the temperature, and the seasons. A list of species of the Mohave desert, arranged by groups, was given, with a discussion of general and particular adaptations.

FILIBERT ROTH: "*Shrinkage of wood as observed under the microscope:*"—In the author's absence the paper was read by title.

L. H. PAMMEL: "*Peziza sclerotiorum;*" and "*Temperature and some of its relations to plant life.*"—In the author's absence these two papers were read by title.

BYRON D. HALSTED: "*Pleospora of Tropæolum majus.*" A fungus of the Alternaria type was found upon the foliage of a garden nasturtium, associated with the perithecia of a Pleospora. Cultures upon slant agar tubes were made of the Alternaria spores and a pure growth of the black mould obtained, followed by the ascigerous form *in* and not upon the surface of the agar. The perithecia were of many and strange shapes, not at all resembling those of the leaves except in the cellular structure of the wall and the size and shape of the spores. This was an unusual instance of the direct modifying effect of the surrounding media upon the size and form of the perithecia. The species is apparently new and may be called *Pleospora Tropæoli.*

BYRON D. HALSTED: "*Secondary spores of anthracnoses.*"—A study of the germinating spores of species of anthracnose shows that the formation of "special cells" or "secondary spores" is probably confined to two genera, viz: Glœosporium and Colletotrichum. They seem to be constantly present in these two genera. Those conditions which are not especially favorable for the production of ordinary spores are well adapted to the formation of secondary ones. There is some uniformity in the color and shape of the special cells, but more in the position they occupy upon the filament. The nature of these cells is not easily determined. They seem to be bodies for enduring periods unfavorable for the growth of the fungus. These cells sometimes increase in number and form a sclerotium, as is well known among some other fungi.

BYRON D. HALSTED: "*A bacterium of Phaseolus.*"—The paper announces the discovery of a new bacterial disease of beans, the species is characterized, and the name Bacterium Phaseolum proposed.

THOMAS MEEHAN: "*The significance of cleistogamy.*"—In the author's absence the paper was read by title.

Proceedings of the Botanical Club of the A. A. A. S.

The first meeting of the Club for the year convened promptly, Thursday, Aug. 18, at 9 A. M. in a room well adapted to the purpose in the main building of Rochester University. An unusually large number of botanists were in attendance. In the absence of both the president, Prof. V. M. Spalding, and the vice-president, Dr. Stanley Coulter, Dr. H. H. Rusby was chosen to preside. The secretary, Mr. D. G. Fairchild, presented his report as treasurer, which was accepted. A contribution from those present, amounting to $4.20, was made to cover the small deficit remaining on the books and to provide for future expenses.

Messrs. Hollick, Barnes and Coville were appointed a committee on nomination of officers for the next meeting. After announcements regarding excursions, a committee on nomenclature was appointed upon motion of Dr. Britton, consisting of Messrs. N. L. Britton, J. M. Coulter, H. H. Rusby, W. A. Kellerman, F. V. Coville, L. M. Underwood and L. F. Ward.

A paper read by Mr. F. V. Coville, mentioned again in the list of papers below, led to the appointment of a committee of three, F. V. Coville, W. J. Beal and B. E. Fernow, to consider the botanical use of the terms *range*, *locality*, *station* and *habitat*. After the reading of papers by Mr. Thos. Morong and Prof. L. M. Underwood, the Club adjourned.

THURSDAY, August 18, 1 P. M.:

Papers were read by Mr. F. B. Maxwell and Mr. W. F. Swingle, both of which led to prolonged discussions, after which the Club adjourned.

FRIDAY, August 19th, 9 A. M.:

The morning session opened with a paper by Mr. Morong upon asclepiadaceous insect traps.

Upon motion of Prof. Beal a vote of thanks was tendered to Dr. E. B. Southwick, botanist of the N. Y. Central Park, for his exhibit of 60 or more species of fruits and nuts, including their branches and leaves, freshly gathered from the park.

The Club has always taken a special interest in the Botanical Division of the U. S. Department of Agriculture, and in accordance with the custom of the Club, the president called upon Dr. Geo. Vasey, the Chief of the Division, to inform

the members in regard to the work now being prosecuted. He said that on account of diminished appropriations the work of the present season is somewhat restricted. The chief field work is in Idaho, by Messrs. Sandberg, Small and MacDougal. Over 53,000 specimens have already been received. The distribution of specimens to agricultural colleges continues. The economic and scientific publications of the Division will continue as heretofore. The third part of the flora of Texas, being prepared by Pres. J. M. Coulter, will be published in a few months. The stations for testing the economic value of native grasses in the arid regions, the first one established four years ago, have been partly abandoned for want of funds. The principal station is at Garden City, Colo., and embraces 160 acres, of which 25 acres are devoted to Bromus inermis, the most successful grass so far tried in the region. Other grasses are also grown in considerable quantities.

Dr. Britton, chairman of the committee, announced that the committee on nomenclature had a unanimous report to submit, which would soon be ready in printed form. It was made the order of business for 1 P. M.

The subject of a World's Congress of botanists next year was brought up by Dr. Arthur, who gave a brief account of the movement to have a congress under the auspices, and forming a part of the general scheme, of the World's Congress Auxiliary, an adjunct organization to the World's Columbian Exposition. A request for an opinion from the committee appointed by the Auxiliary regarding the feasibility of carrying out the plans already outlined, was answered by Dr. Arthur, who said that the committee were not sanguine of success. Dr. Barnes moved "that it is the sense of the Botanical Club of the A. A. A. S. that it is inexpedient to attempt to hold an International Congress in connection with the World's Columbian Exposition in Chicago in the summer of 1893," which was unanimously adopted.[1]

The desirability of emphasizing in some way the next year's gathering of botanists was now brought forward by Dr. Arthur, and a committee of three members of the Club, Messrs.

[1] It may be noted in this connection that the Section of Biology, F, subsequently passed the following:

Resolved, That this Section appoint as its committee the outgoing officers of Section F, and the incoming officers of Sections F and G, to confer and co-operate at their discretion with World's Congress Auxiliary.

J. C. Arthur, B. L. Robinson and T. H. McBride, was appointed to report to the Club at a later session in regard to the matter.

The morning session closed with a paper by Mr. O. F. Cook.

FRIDAY, August 19, 1 P. M.:

The committee on nomenclature presented its report in printed form, which was adopted, article by article, with only a few verbal changes, as follows:

Resolved, That the Paris code of 1867 be adopted except where it conflicts with the following recommendations:

I. *The Law of Priority.*—Priority of publication is to be regarded as the fundamental principle of botanical nomenclature.

II. *Beginning of Botanical Nomenclature.*—The botanical nomenclature of both genera and species is to begin with the publication of the first edition of Linnæus' *Species Plantarum*, in 1753.

III. *Stability of Specific Names.*— In the transfer of a species to a genus other than the one under which it was first published the original specific name is to be retained, unless it is identical with the generic name or with a specific name previously used in that genus.

IV. *Homonyms.*— The publication of a generic name or a binomial invalidates the use of the same name for any subsequently published genus or species respectively.

V. *Publication of Genera.*—Publication of a genus consists only (1) in the distribution of a printed description of the genus named; (2) in the publication of the name of the genus and the citation of one or more previously published species as examples or types of the genus, with or without a diagnosis.

VI. *Publication of Species.*—Publication of a species consists only (1) in the distribution of a printed description of the species named; (2) in the publishing of a binomial, with reference to a previously published species as a type.

VII. *Similar Generic Names.*—Similar generic names are not to be rejected on account of slight differences, except in the spelling of the same word; for example *Apios* and *Apium* are to be retained, but of *Epidendrum* and *Epidendron*, *Asterocarpus* and *Astrocarpus*, the later is to be rejected.

VIII. *Citation of Authorities.*—In the case of a species which has been transferred from one genus to another the original author must always be cited in parenthesis, followed by the author of the new binomial.

N. L. BRITTON, JOHN M. COULTER, HENRY H. RUSBY, WILLIAM A. KELLERMAN, FREDERICK V. COVILLE, LUCIEN M. UNDERWOOD, LESTER F. WARD,

Committee.

The main discussion upon this report was under article VI in regard to the acceptance of named exsiccati not accompanied by a description as valid publication of a species, which was discussed by Messrs. Beal, Coulter, Vasey, Swingle, Bailey, Kellerman, Barnes, Fernow, Cook, Dudley, Morong, Britton, Underwood and Johnson. The motion to amend by including exsiccati was lost.

Dr. Britton moved that a permanent committee be appointed to serve as a board of arbitration, and to prepare and print a list of the flowering plants within the area of the sixth edition

of Gray's Manual in accordance with the recent report on nomenclature. It was subsequently agreed to extend the range to include Canada, Nebraska and Kansas. On motion of Dr. Arthur, the nomenclature committee was made the permanent committee for this purpose. A further motion was carried "that this committee be empowered to receive all suggestions and criticisms of this list, and to report upon them at the next year's meeting."

MONDAY, August 22d, 9 A. M.:

In absence of the acting president, Dr. H. L. Russell was called to the chair. The committee on nomination of officers for next year reported the names of Dr. W. P. Wilson of the University of Pennsylvania for president, Prof. W. A. Kellerman of the University of Ohio, for vice-president, and Prof. T. H. McBride, of the University of Iowa for secretary. They were elected unamiously.

Papers were then read by Mrs. E. G. Britton, Dr. B. D. Halsted, Mr. F. V. Coville, Dr. N. L. Britton, Dr. J. C. Arthur, and Dr. L. M. Underwood.

The following motion presented by Dr. Britton was approved:

"That Dr. Lucien M. Underwoood be delegated to represent this association of American botanists at the International Botanical Congress to be held at Genoa, Italy, Sept. 4–11, 1892."

A committee of three was then appointed to obtain funds by subscription to defray the expenses of the delegate. Drs. J. M. Coulter, W. P. Wilson and E. F. Smith were named such committee.

MONDAY, August 22d, 1:00 P. M.:

The club was called to order with vice-president Wilson in the chair. The committee on plans for the next year's meeting presented a report recommending:

I. (1) That the officers of the section of botany for 1893 (vice-president and secretary) shall, together with one person to be chosen by the Botanical Club, constitute a committee to whom is referred the arrangement of a special program for the meeting of 1893.

(2) That this program shall include among other matters certain special topics selected by the committee.

(3) That each topic shall be introduced by a paper presented by some person to whom the topic has, with his consent, been assigned.

(4) That upon completion of the preliminary program and other arrangements a printed statement with an invitation to be present at the meeting be sent to both American and foreign botanists.

II. That a committee of three, of which Dr. N. L. Britton shall be chairman, be appointed to make such arrangements for special excursions at the close of the meeting as may be found practicable and desirable.

The matter of a new society of botanists, to more fully unify and subserve the botanical interests of the country, was next introduced by Prof. L. H. Bailey. After some discussion, showing a general belief that such a society was desirable, but with some doubts as to the advisability of establishing it at the present time, a committee of nine was appointed "to consider the formation of an American Botanical Society, after obtaining the views of the botanists of America on the proposition, and report thereon at the meeting of the Club next year."

Papers were read by Mrs. E. G. Britton, Mr. A. A. Crozier, Dr. W. P. Wilson and Dr. N. L. Britton.

TUESDAY, AUGUST 23d, 1:30 P. M.:

Acting President Wilson announced the following committees: On program for Madison meeting, Chas. E. Bessey, Frederick V. Coville and Chas. R. Barnes; on botanical excursions at the close of the Madison meeting, N. L. Britton, Wm. Trelease and Douglass H. Campbell; on the establishment of an American Botanical Society, L. H. Bailey, W. G. Farlow, Emily L. Gregory, Byron D. Halsted, James Fletcher, Douglass H. Campbell, Charles R. Barnes, F. Lamson-Scribner and Lester F. Ward. On motion of Dr. Britton the name of W. P. Wilson was added to the last committee.

The committee on the use of certain topographical terms brought to the attention of the Club by Mr. Coville on the first day of the session, reported through its chairman, Mr. B. E. Fernow, that a unanimous decision had not yet been reached. On motion the committee was continued to report at the next year's meeting.

Papers were read by Mrs. Wolcott and Mr. Chas. Mohr. The Club adjourned to meet at Madison, Wisconsin, in 1893.

COMMENTS.

The attendance upon the meetings of the Club throughout was excellent, quite equaling that of the Section of Biology. Many more papers were listed than could be read for want of time, and others would doubtless have been presented if the authors had seen any probability of gaining a hearing. Never in the history of the Club have so many matters of general interest, which may be grouped under the caption of "business," come before the Club for decision. In fact the time

consumed in transacting business, although conserved to the utmost by the watchfulness of the chair, and the assistance of committees, seriously interfered with the reading of papers, and introduced an element of irregularity and uncertainty into the program that detracted somewhat from the general interest which usually centers upon the hearing of papers and their discussion. Hereafter matters of this class will doubtless largely come before the newly formed Section of Botany.

If the business brought before this meeting was considerable and somewhat burdensome, it is pleasant to reflect that for the most part it sustained more than usually important relations to the general welfare of American botanical science, and that the large number of able and representative men present must go far toward insuring approval of the decisions from other botanists, who had not the privilege of being in attendance. The full list of botanists present can not be given for want of space, but a few may be mentioned, viz: L. H. Bailey, Cornell Univ. N. Y.;W. J. Beal, Mich. Agr. Coll.; N. L. Britton, Columbia Coll., N. Y.; Mrs. E. G. Britton, N. Y.; O. F. Cook, N. Y.; J. M. Coulter, Ind. Univ.; J. C. Arthur, Purdue Univ., Ind.; C. R. Barnes, Univ. of Wis.; F. V. Coville, U. S. Div. of Botany; W. R. Dudley, Leland Stanford Univ., Cal.; D. G. Fairchild, U. S. Div. of Veg. Path.; B. E. Fernow, U. S. Div. of Forestry; B. D. Halsted, N. J. Exper. Station; Arthur Hollick, N. Y.; W. A. Kellerman, Univ. of Ohio; T. H. McBride, Univ. of Iowa; Charles Mohr, Ala.; Thomas Morong, Columbia Coll., N. Y.; B. L. Robinson, Harvard Univ., Mass.; H. H. Rusby, Coll of Pharmacy, N. Y.; H. L. Russell, Univ. of Chicago, Ill.; F. L. Scribner, Univ. of Tenn.; E. F. Smith, U. S. Div. of Veg. Path.; G. B. Sudworth, U. S. Div. of Forestry; W. T. Swingle, U. S. Div. of Veg. Path.; M. B. Thomas, Wabash Coll., Ind.; Wm. Trelease, Mo. Bot. Garden; L. M. Underwood, De Pauw Univ., Ind.; Geo. Vasey, U. S. Div. of Botany; M. B. Waite, U. S. Div. of Veg. Path.; L. F. Ward, Smithsonian Inst., D. C.; and W. P. Wilson, Univ. of Penn.

Papers presented to the Botanical Club of the A. A. A. S.

For the first time in the history of the Club the daily program was printed as part of the daily program of the A. A. A. S., which proved a great convenience. The advantage of knowing what papers were upon the list, however, was largely neutralized by the miscellaneous introduction of business, which took much of the time, and made it impossible for either readers or auditors to judge when a paper would be called. The volume of the business transacted accounts for the comparatively small number of papers read, and the many left unread.

The following papers were read:

AUGUST 18TH, MORNING SESSION.

F. V. COVILLE: *Use of the terms range, locality, station and habitat.*—The confusion in the botanical use of these words was pointed out. A definition of each was submitted and their usage in accordance with the same illustrated. The discussion was participated in by Dr. C. R. Barnes, Dr. N. L. Britton, Mr. W. H. Seaman, Mr. B. E. Fernow, and Dr. Thomas Morong, and in the main supported the views put forth by the author.

THOMAS MORONG: *Travels in Paraguay, and its flora.*—The author prefaced his paper by saying that when in Paraguay he had received the expression of good will and sympathy sent by the Club in session at Toronto in 1889, and he now desired at the first opportunity he had had, to specially thank the Club for its courtesy, and to further show his appreciation he had prepared the present paper, briefly giving an outline of his travels. The author then read a very interesting account of the territory traversed, the perils and interruptions encountered, and especially of the nature of the vegetation. Drs. Rusby and Britton added some information, particularly in regard to the dangers of the trip and its happy termination.

L. M. UNDERWOOD: *A variety of Polypodium vulgare, new to America.*—This much altered form was found on Mohawk Mt., Conn., and was believed to be worthy the rank of a variety. Specimens were shown. The author took the opportunity to exhibit specimens of Onoclea sensibilis, in which the sterile fronds had been destroyed, and the later-appearing fertile fronds had unrolled, taking on a shape intermediate between the usual sterile and fertile fronds, and becoming as-

similatively active. This form, the so-called var. obtusilobata, he believed always to arise from injury to the vegetative fronds of the plant, and to be in no wise due to hybridity.

AUGUST 18TH, AFTERNOON SESSION.

F. B. MAXWELL: *Symbiotic growths in the roots of Ranunculaceæ.*

W. T. SWINGLE: *Some rare and interesting fungi from Florida.*—Specimens were shown and a description of the development, so far as known, was given of new parasites of more than usual interest. An ascomycetous species, in some respects resembling Claviceps, attacked and totally destroyed the inflorescence of Cenchrus tribuloides.

AUGUST 19TH, MORNING SESSION.

THOMAS MORONG: *Observations upon certain species of Asclepiadaceæ as insect traps.*—The conclusion was reached that the parts holding the insect were sensitive, and were brought firmly together by the irritation due to the presence of the insect's proboscis. The author also took the opportunity to exhibit fresh specimens of his Nuphar rubrodiscum, which, upon further study, he still believed to be a good species. If it were to be degraded to a variety, he thought it should go under N. Kalmianum, and not under N. advena, as in the last edition of Gray's Manual.

O. F. COOK: *General notes upon the flora of Liberia.*—The general topography, climate and appearance of the vegetation were described. It is moist and warm the year round, there being no true dry season. Coniferæ are entirely absent. Aquatic plants and mosses are scarce, but hepatics are wonderfully abundant, both in species and individuals. A tree-like lycopod, 8 to 10 feet high, is a common and beautiful object. Agaricini and Polyporei are very common, and of most bewildering complexity of forms. Gasteromycetes are rare, and parasitic fungi of all kinds almost wholly absent. Even the cultivated plants are without rusts, smuts, mildews or leaf-spots.

AUGUST 19TH, AFTERNOON SESSION.

No papers were read.

AUGUST 22D, MORNING SESSION.

MRS. E. G. BRITTON: *On the proposed handbook of mosses of Eastern America.*—Drawings prepared to illustrate this work were exhibited and the general plan of the work described.

B. D. HALSTED: *Weeds and weed roots.*—Photographs of the plants described in his "Century of American Weeds," and also of the root systems of classified groups of these weeds were shown.

F. V. COVILLE: *The re-discovery of Juncus Cooperi.*

N. L. BRITTON: *The North American Amelanchiers.*—There appear two well marked species along the eastern coast: A. Canadensis, an upland form with birch-like leaves, and A. spicata, a swamp form of smaller growth and more spicate inflorescence. These do not appear to intergrade, but their western range and variations are not yet well known. Beside these two, the other species of the genus were briefly described and illustrated with herbarium specimens. The genus is believed to contain seven American species. Material for study, especially from the interior, is solicited.

J. C. ARTHUR: *A new form of root cage.*—This consists essentially of two glass plates held about an eighth of an inch apart by removable metal clips, between which the soil is placed and the plants grown. The glass plates are so close together that nearly or quite all the roots may be seen from one side or the other during the whole period of growth. The glass cage is set in a convenient zinc trough for holding water, and the roots protected from light by zinc sides. It is designed for the study of geotropism, the relation of roots to soils, etc.

N. L. BRITTON: *The botanical garden movement in New York.*—The present very favorable condition of the project for a New York garden was outlined, and the opinion given that it would be established in a year or two, and under favorable regulations for its scientific control. Dr. E. F. Smith expressed the gratification felt by all botanists that a garden of such size and prospective value was soon to be added to the few at present in America.

L. M. UNDERWOOD: *A few additions to the hepatic flora of the Manual region.*

AUGUST 22D, AFTERNOON SESSION.

MRS. E. G. BRITTON: *On the genus Campylopus in North America.*—After a general account of the genus, the author spoke of a new species, *C. Millspaughi*, which has been separated from *C. flexuosus*, with abundant material for distribution. Two other new species were mentioned, and drawings and specimens exhibited.

A. A. CROZIER: *Note on a recent outbreak of peach yellows near Ann Arbor, Michigan.*—Described isolated outbreaks of the disease, and its gradual spread from centers of infection, in such manner that the theory of its contagious nature was well borne out.

W. P. WILSON: *Some observations on Epigæa repens.*—This species, as well known, is polymorphic. It appears to have once been trimorphic, but now possesses all intermediate forms. The female flowers have no pollen, and usually no anthers, and sometimes even no trace of stamens. The male flowers are without stigmas. The staminate and pistillate plants are so distinct in appearance as to be told at a distance. The female form is the more vigorous and predominant, but seed production is rare. Prof. Halsted called attention to the fact that there was only one size of pollen.

N. L. BRITTON: *Notes on some species of Cratægus.*—The forms of this genus are many of them difficult to distinguish, and more material and study is needed. *C. flabellata* Bosc., an extremely rare form from Canada, and *C. glandulosa*, from Delaware, with large and abundant glands upon the inflorescence, need especial attention.

AUGUST 23D, AFTERNOON SESSION.

MRS. H. L. WOLCOTT: *Observations on the ripening of the seeds of Cuphea.*—Attention was called to a cultivated variety with large flowers, which pushed the placenta laterally through the walls of the ruptured ovary and calyx tube, bringing the immature seeds into the air to ripen. Dr. Britton mentioned that the adaptation also occurred in Cuphea viscosissima.

CHAS. MOHR: *Notes on the mountain flora of northern Alabama.*—This paper will soon appear in *Garden and Forest.*

The following papers still remained upon the program unread at the final adjournment:

A. S. HITCHCOCK: *Notes on some Kansas weeds.*

W. W. BAILEY: *Notes on the flora of Block Island.*

L. H. PAMMEL: *Notes on the distribution of a few plants.*

L. H. PAMMEL: *Phaenological notes for 1892.*

THEO. HOLM: *Notes on terminology.*

MRS. E. G. BRITTON: *On the genus Ditrichum in North America with one Western species and corrections for two Eastern species.*

THOMAS MORONG: *Notes upon a revision of the North American Naidaceæ.*

M. B. WAITE: *Notes on some pear and apple diseases.*

E. S. GOFF: *Modifications of the tomato plant resulting from seed selection.*

MRS. E. G. BRITTON: *Some of the rare mosses of White Top and vicinity recently collected on a trip to southwestern Virginia.*

J. C. ARTHUR: *Galvanotropism.*

A. A. CROZIER: *A botanical terminology.*

MRS. E. G. BRITTON: *A proposed collection of mosses of New York state for the Columbian Exposition.*

W. P. WILSON: *Climbing habit of Tillandsia usneoides.*

O. F. COOK: *Some general questions in the classification of Myxomycetes.*

J. M. COULTER: *North American Cacti.*

L. H. BAILEY: *Cultivated species of Brassica.*

P. H. ROLFE: *Notes on the distribution of plants in Florida.*

L. H. PAMMEL: *Notes on some fungi common during the season of 1892 at Ames, Iowa.*

BRIEFER ARTICLES.

Polygonum persicarioides HBK. — According to Hemsley (Biol. Cent. Am. III, 34) the range of this plant is from Mexico to Chili and Peru. It is represented in the National Herbarium by the Wilkes' Expedition plant from Lima, Peru; by an unnamed plant collected by Botteri near Orizaba, Mexico, and numbered 1163; and by three plants that had been referred to *Polygonum persicaria* L., viz., Palmer's no. 137, collected in 1885 in S. W. Chihuahua, Mex.: Palmer's no. 211, collected in 1887 near Angeles Bay, Lower California; and the Mexican Boundary Survey plant no. 1183, collected in the valley of the Rio Grande, below Donna Ana, N. Mex. Recently Mr. H. Wurzlow sent this species from Industry, Austin Co., Texas, which extends its range into the United States.

All these plants mentioned agree essentially with the description in HBK., Gen. Pl. II, 179, with some exceptions. First, the leaves are not glabrous below, but *above;* while *below* they are "beset with numerous minute hairs." I may add: midrib below and margin beset

with coarser appressed hairs in all our specimens. It must be that the first description is wrong on this point. Then, the leaves are in no case "7—8 lines wide," but ⅜ in. to ½ in.; the Angeles Bay plant having some leaves as wide as ⅝ in. Furthermore, the description has "Calyx 4-parted . . . Stamens 6 according to Bonpland. . . . Achene lenticular." I have frequently found the calyx 5-parted, stamens as many as 8, and the achenes in the Angeles Bay and the Orizaba plant—the latter from one of the stations cited in Biol. Centr. Am. l. c.—as well as in the Texas plant, are triangular: all, however, of the same size, and all "umbonate," as in the first description.

This species is distinguished from *P. persicaria* L. by its narrower, longer leaves, more slender spikes and smaller achenes.—J. M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

New Mosses of North America.—The following brief diagnoses are published in advance of fuller descriptions in order to secure priority. We hope to prepare shortly the fifth number of our series under the above title, in THE BOTANICAL GAZETTE.

Dichodontium olympicum n. sp.—A D. *pellucida* jam multo robustiore primo visu differt: foliis valde papillosis, toto fere ambitu minute denticulatis, capsulaque basi strumosa. Planta humilis, vix 1 cent. alta.—Olympic Mts., Wash. (*L. F. Henderson.*)

Grimmia Hendersoni n. sp.—*G. decipienti* Lindb. (G. *Schultzii* Wils.) proxima sed ab ea pedicello longiore, capsula subcylindrica magis elongata, operculo longius rostrato et foliorum rete basilari multo laxiore facillima distinguenda.—Hood River, Oregon, on dry rocks. (*L. F. Henderson*).

Encalypta lacera n. sp.—Ab *Enc. vulgari* proxima differt calyptra basi lacerata, peristomio e membrana alba fugacissima lacerata composito et pedicello longiore.—Milwaukie, Oregon, Willamette River, (*L. F. Henderson*).

Leskea obtusa n. sp.—Formis robustioribus *L. polycarpæ* similis. sed ab illis primo aspectu foliis obtusis marginibus planis distincta, A *L. obscura* habitu valde robustiore, foliis majoribus et magis obtusis, costa breviore et capsula majore et longiore quoque differt.—Bethlehem, Pa., mixed with *Anomodon obtusifolius* (*Rau.*) Chinchuba, La., near Mandeville, on trees (*Langlois*).—F. RENAULD AND J. CARDOT, *Monaco, and Stenay, France.*

EDITORIAL.

THE RECENT upheavals in nomenclature, culminating in the work of Otto Kuntze, are too well known to need recapitulation. It had become evident to most botanists that some agreement must be reached or confusion would become worse confounded. This feeling found public expression in Europe in the circular recently issued from Berlin,[1] containing certain propositions which were submitted to working botanists for their signature. It is presumed that the results thus obtained were to be presented to the International Congress at Genoa. In this country a circular with the same purpose was sent out from New York and Washington, and was the means of discovering among botanists a wide-spread desire for an agreement upon matters of nomenclature. It was felt that work in systematic botany was losing force amidst the uncertainties of nomenclature, and that almost any laws were preferable to the existing chaos.

THE TIME therefore seemed ripe at the Rochester meeting of the Botanical Club for an attempt to reach some mutual understanding. As is shown in the account of the meeting, the attendance of botanists who have to deal with nomenclature was unusually large, and it was felt to be representative, especially when taken in connection with letters containing expressions of opinion from many who were absent. The subject was not sprung in a formal meeting, but about twenty-five botanists, representing every shade of opinion, met informally and thoroughly and frankly discussed every point. Every one was ready to make concessions for the sake of agreement, and the principles finally adopted represent a resultant of various concessions. It was felt that this amicable feeling must be strengthened by an immediate agreement of some kind, and that various details could be arranged afterwards. The principles proposed were adopted by the Botanical Club with remarkable unanimity, the only real question raised being as to the advisability of so rigidly restricting the publication of species, some thinking that distributed specimens bearing a name should be included.

IN THE OPINION of the GAZETTE the paper adopted represents a thoroughly wise compromise, alike honorable to all concerned in its preparation, as witnessing a far greater desire to steady nomenclature than to hold fast to individual opinion. This is the spirit in which it should be received by all American botanists, and small differences of opinion should be lost sight of for the general good.

THIS ACTION of American botanists will be presented at Genoa, as

[1] See this journal for August, p. 267.

representing their proposition in the direction of an international agreement. As it is not widely different from the Berlin propositions some agreement may be reached, but we should not be too sanguine concerning this. If the Genoa Congress adopts a set of principles so little at variance with our own that complete agreement is possible, the standing committee is authorized to submit the matter to a vote (by mail) of the American botanists.

IT WAS a wise thing to appoint a standing committee to prepare a tentative list of the flowering plants of the so-called "Manual range" under the rules adopted and present it at the next meeting of the Club or of the new Botanical Section of the American Association. This will give the most conspicuous example of the working of these rules that could be selected from our flora, and botanists can have before them a concrete illustration, and can then determine whether the principles adopted work reasonably well or not. In the opinion of the GAZETTE the changes that will follow in Manual names will be much fewer than many suppose.

IN THIS CONNECTION it may be well to call attention to a single provision of the adopted rules; which is, to make 1753 (Linn. *Sp. Plant., ed. 1*) as the common point of departure for both genera and species. This will do away with a number of generic names that have been recently revived, and is better in this regard than the Berlin proposition, which takes the fourth edition of Linnæus' *Genera Plantarum* (1752) as the point of departure for genera. If the 1753 date is adopted at Genoa, the list of genera which are proposed by the Berlin circular as exceptions will be shortened, and in fact so few that concern American botanists will be left that they should not be considered when involving a dangerous precedent.

THE ROCHESTER MEETING bids fair to mark an epoch for American botanists. Not only was an agreement concerning nomenclature reached, but botany was dignified by being made a distinct section of the American Association. It will be long before section G sounds as home-like as section F, but as the botanists were suing for the divorce it was graceful to leave the house in the possession of zoology. However, the divorce is not complete, for provision was made by which joint sessions are to be held for hearing papers of general biological interest. The GAZETTE has so frequently given the reasons that have been urged for this separation that they must be familiar. The same reasons were overwhelmingly evident at Rochester, where the flood of botanical papers was beyond all precedent. The botanists are now responsible for a section, and they can begin the preparation of papers for the next meeting in the full assurance of having not only time for a hearing, but also for discussion.

The action of the Botanical Club, of course fully representing the new section G, in reference to the International Botanical Congress in connection with the Columbian Exposition, was thoroughly prudent. By correspondence and by personal investigation it had become sufficiently evident that a very meager representation of European botanists could be expected, and that nothing was to be gained by coöperation with the World's Congress Auxiliary. It seemed somewhat absurd to call a meeting of American botanists an "International Congress." However, the attractions of the year are to be taken advantage of, and foreign botanists urged to attend themeeting of the Botanical Club, which has a committee appointed to do all it can towards making their stay pleasant and profitable.

CURRENT LITERATURE.

The lower cryptogams.[1]

Professor Ludwig of Greiz is known as one of the most energetic German students of the mutual relations between plants and animals, and of the fungi, especially those connected with some of the obscure gum diseases of trees. For a series of years he has reviewed mycological literature for Just's Jahresbericht, which has caused him to become quite familiar with the work being done by specialists in that field, so that his text-book is unusually rich in references to recent work. The book is essentially a review of the thallophytes, with especial reference to economic questions, nearly 600 pages being devoted to the fungi, and only about one-tenth as much to the algæ, inclusive of lichens. A full index makes reference to the cryptogams themselves, as well as host plants, etc., quite easy, although the hosts are indexed only under their common names. The book appears to be carefully and well written.—W. T.

Minor notices.

Professor Greene's *Pittonia* (vol. II, pt. 11; May–Aug., 1892) contains a very interesting paper upon Dr. Kuntze and his reviewers, chiefly the latter. The reviewers referred to are Hemsley (*Nature*), Jackson (*Jour. Bot.*), Britton (*Bull. Torr. Bot. Club*), and Schumann

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[1] Ludwig, Friedrich.—Lehrbuch der niederen Kryptogamen, mit besonderer Berücksichtigung derjenigen Arten, die für den Menschen von Bedeutung sind, oder in Aeushalte der Natur eine hervorragende Rolle spielen.—8vo, pp. xvi+672. Stuttgart, Enke, 1892.

(*Nat. Rund.*). The reviewer of reviews, while acknowledging in a general way that he may have been even more radical than Kuntze, cannot subscribe to all his views, although this probably refers to certain minor points. He points out very clearly that this much criticised author has the merit of consistency in his application of the "Paris Code," a fact which would seem to indicate that the time has come to guard the workings of the code. Professor Greene regards Kuntze's work as the most important contribution to the literature of nomenclature that has ever been made and one for which all botanists should be grateful, an opinion which THE GAZETTE has already expressed.

IN THE SAME publication Bentham's genus *Linanthus* is restored to include some twenty-five species which have been usually placed under *Gilia*. Many new species from the wonderful Pacific coast flora are also described.

PROFESSOR A. C. APGAR is the author of a small book dealing with the trees of the Northern United States[1]. There can be no doubt that the trees are too much neglected by pupils in botany, and that many a person becomes familiar with the herbaceous flora of his neighborhood without being able to recognize the trees. This book is prepared for the easy determination of our trees, cultivated as well as indigenous. As it does not profess to be written for the professional botanist it should be judged merely from its adaptation to its audience. An easy analytical key to genera is provided, and illustrations are plentifully sprinkled through the text. There is no reason why this book should not be very useful in enabling students to become acquainted with trees, a thing much to be desired.

DR. W. J. BEAL AND MR. C. F. WHEELER have published a catalogue of Michigan plants[2], which is based upon the Wheeler & Smith catalogue of 1880. The pamphlet contains some 70 pages of valuable prefatory material, discussing from numerous points of view the flora of the state, and including many group lists. The catalogue contains 1746 numbers, including the pteridophytes. The publication is a valuable addition to our increasing list of useful local catalogues.

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[1] APGAR, AUSTIN C.—Trees of the Northern United States, their study, description and determination, for the use of schools and private students. 8vo. pp. 224. American Book Company: New York, Cincinnati, Chicago.

[2] BEAL, W. J. and WHEELER, C. F.—Michigan Flora. Prepared for the 30th Ann. Rep. of the Sec'y of the State Board of Agric. 8vo. pp. 180. Lansing, 1892.

OPEN LETTERS.

Dr. J. P. Campbell's "Biological Instruction."

I was interested to read in the last number of THE GAZETTE an appreciative review of the recent work of Dr. J. P. Campbell of the University of Georgia concerning the methods of biological instruction in American colleges and universities. On account of the inadequate treatment given the subject of botany in the chapter of Dr. Campbell's work which refers to the University of Minnesota, I wrote asking him to explain why he had neglected a department which might have claimed some attention in such a book as he was putting forth. I received from him a reply that is so complete an exposition of his intellectual position and capacity for undertaking the broad treatment of biological instruction in the United States that I cannot refrain from giving a few sentences wider circulation. Since the letter was in no way confidential I feel at liberty to do this. Dr. Campbell begins by exhibiting great surprise and indignation that I should have dared to call him to account for his inaccuracies. He says: "I am not accustomed to being called to account and asked if I 'have any explanation to offer' nor do I recognize the right of any one to do so, and this letter is only written on the assumption that you expressed yourself more strongly than you thought." In reply I called Dr. Campbell's attention to the fact that in the taking up of such a work as he had attempted he had exposed himself to criticism, and that he would find as his experience in publishing grew wider he might often merit and receive criticism and correction. He assures me in his letter that a circular was sent from Washington to the professor of biology at each institution and from the replies to these circulars his work was compiled. I am informed by Professor C. W. Hall (at that time professor of biology at the University of Minnesota) that he received no such circular; but one was received by the professor of *animal* biology, Dr. H. F. Nachtrieb. This indicates the care with which Dr. Campbell's circulars were sent out. Further, in the list of teachers there was no mention of Professor Hall's name while there was of Professor Nachtrieb's, showing how carefully this table was arranged.

Observing the extraordinary and altogether unnecessary impression that Johns Hopkins University seemed to have made upon Dr. Campbell I took occasion in my letter to him to express my high appreciation of the zoölogical work done at that institution and my very low appreciation of the biological work done by any institution where they are willing to omit one-half of the science. Indeed I indicated a certain feeling of contempt for the burglarious use of the word "biology" which is permitted at this institution which has had such an extraordinary influence upon American biological instruction. To this Dr. Campbell replies with characteristic vigor and enthusiasm. He says: "I cannot help thinking if you had stayed longer at Johns Hopkins and caught more of the spirit of the place you would have found that the instruction in biology is not by any means 'weak' as you are pleased to term it, but that it has taken its present form, so far at least as the strictly undergraduate work goes, simply because they are unhampered by traditions and are free to carry out their ideas of the

relative importance of subjects, and these I admit are a little in advance of the times. In the five years that I worked there I frequently heard the value of botany insisted upon for training children and I also heard Dr. Martin emphasize the necessity of studying animal and vegetable forms together as in the general biology course."

We have here the pleasing suggestion that botanical work is of value for training children! It would be difficult to ask for a more perfect exhibition of the spirit with which Dr. Campbell came to his task of writing a broad account of biological instruction in America. I should be far from holding Johns Hopkins responsible for any indiscretion of Dr. Campbell, but under the circumstances it seems a matter of distinct regret that any institution in America should permit a man to graduate from a five years course in biology with the notion that the science of our food-supply, to put it upon a purely economic basis to say nothing of any other, is a fit thing to amuse children with. It is, too, an interesting thing to note in these days of specialization, that it is the zoölogist who wishes to talk of "biology" (which is after all only a synonym of the old phrase, "natural history"); while the botanists, recognising the twin sciences, are willing to give each a place and name. It is possible that the botanists are somewhat in advance of the times, as Dr. Campbell would say.

I have written thus at length because I feel that I am in a position to show the botanists of the country somewhat of the animus that has been displayed in the compilation under government control of what should have been a valuable, accurate, broad-minded, adequate and complete account of the biological work in American colleges. It is unfortunate that it was intrusted to a gentleman who after five years of what he supposes is biological instruction—and I have no reason to think that Dr. Campbell is insincere in supposing that he is a biologist—has the pleasant way of characterising botany as valuable for the training of children.—CONWAY MACMILLAN, *University of Minnesota, Minneapolis.*

NOTES AND NEWS.

MR. W. W. CALKINS has some interesting words regarding the study of lichens in America, in *Science* for August 26.

PROFESSOR GEO. F. ATKINSON has been appointed Assistant Professor of Cryptogamic Botany at Cornell University.

MR. HENRY E. SEATON, Instructor in Botany in Indiana University, has been appointed Assistant Curator at the Harvard Herbarium.

DR. GEORGE VASEY is the accredited representative of the Department of Agriculture and Smithsonian Institution to the International Congress of Botanists at Genoa.

A PRESENTATION of the question of priority in botanical nomenclature from the ethical point of view is given by Prof. L. M. Underwood in *Science* for Aug. 26 (xx, 16).

THE OFFICERS of the new section of botany, G, of the A. A. A. S. for the ensuing year are Dr. Charles E. Bessey of the University of Nebraska, vice-president, and Mr. F. V. Coville, of the U. S. Division of Botany, secretary.

DR. J. C. ARTHUR returned from his European trip early in August, and reports that some botanists, including a few of the most renowned, will probably visit this country next year, but the number is not likely to be large.

PROFESSOR WM. R. DUDLEY, of Cornell University, has been appointed Professor of Systematic Botany at Stanford University. Professor Dudley's work will largely be in the direction of studies in geographical distribution, for which the University is so favorably situated.

FOR THE FIRST TIME in the history of the Botanical Club there was no excursion or reception designed especially for botanists during the recent meeting. The local committee tendered an afternoon excursion to the Club, however, which could not be accepted for lack of time. Upon Saturday each botanist chose the excursion he preferred, there being no pre-arrangement.

DR. B. L. ROBINSON has been appointed Curator of the Harvard Herbarium, and arrangements have been made by which he can have time at his disposal for the completion of the Synoptical Flora. It is the present intention to push this great work as rapidly as possible, an intention which will be warmly commended by American botanists, who were fearful that it might be abandoned altogether.

THE BOTANICAL INSTITUTE at Munich, Germany, is prospering greatly under the management of Prof. Dr. Goebel, who took charge less than a year ago. The building has been renovated, and a considerable addition is now in course of construction, which will contain laboratories for physiological work. The supply of alcoholic and dried material for illustrative purpose has also been much increased, and a series of charts of large size has been specially prepared.

THE CONSPICUOUS ITEMS in the proceedings of the Rochester meeting of the Botanical Club are: (1) the nomenclature agreement; (2) the appointment of Professor Underwood as the Club's representative at Genoa; (3) the action with reference to an International Congress of botanists in connection with the Columbian Exposition; (4) the appointment of a committee to define the terms "range," "locality," "station," and "habitat"; (5) the appointment of a standing committee to prepare a list of plants of the "Manual range" under the adopted rules.

NO SMALL PART of the credit for the large attendance of botanists at the recent gathering in Rochester, and for the unusually full list of papers presented before the Botanical Club, is due to Mr. D. G. Fairchild, the secretary of the Club. By correspondence and solicitation before the meeting he was enabled to present upon the first day of the session a long list of names of those who had signified their intention of being present, and of papers which were to be read. It is

work of this kind which creates and sustains unusual interest in scientific gatherings, and it is a pleasure to note the disinterested and efficient manner in which the present secretary of the Club has performed such self-imposed duties.

THE FOLLOWING PAPERS were read before the Botanical Sub-Section of the British Association for the Advancement of Science, on Friday, August 5th, at the meeting in Edinburgh: "A proposed World's Congress of Botanists at Chicago in 1893," by Dr. J. C. Arthur of La Fayette, Ind., U. S. A.; "Observations on secondary tissues in monocotyledons," by Dr. Scott and Mr. Brebner; "On the simplest form of mosses," by Prof. K. Goebel of Munich, Germany; "On the cause of physiological action at a distance," by Prof. Léo Errera of Brussels, Belgium; "Notes on the morphology of the spore-bearing members in the vascular cryptogams," by Professor Bower; "Notes on an aposporous fern-seedling," by C. T. Druery; "A Chytridian parasitic on Cyclops' eggs," by Prof. M. Hartog; "Arrangement of the buds in Lemna minor," by Miss Nina Layard. Other botanical papers were read on the following Tuesday.

A RECENT ANNOUNCEMENT of the University of Minnesota states that the laboratories of botany occupy a suite of rooms in Pillsbury Hall, viz: (1) herbarium and seminar rooms, (2) a student's morphological and chemical laboratory, (3) an experimental physiology laboratory, (4) a special laboratory, office and reading room, (5) a dark room, (6) a special work room. These with other rooms give a floor space of 6,000 square feet. The laboratory contains microscopes, auxanometers, clinostats after Pfeffer's patterns, thermo-electric apparatus, a Mackintosh lantern, microtomes after Minot and Jung-Thoma, centrifugal wheels, induction coils, heliostat, Lautenschlager's bacterioscopic and sterilizing apparatus, water-motor, balances, thermometers, etc., giving full facilities for elementary, advanced and original work in the field of botany, considered in its widest sense. The herbarium contains over 60,000 specimens. A botanical museum and economic collection has been begun.

IN VIEW of the fact that the nomenclature agreement was the result of a movement inaugurated by the Berlin circular, published in the last number of the GAZETTE, and of the New York and Washington circular, the principles proposed by the latter are here put on record:

I. The adoption of initial dates for generic and specific names.

II. That the publication of a generic name or a binomial specific name invalidates the use of the same name for any subsequently published genus or species.

III. That in the transfer of a species to a genus other than the one under which it was first published, the original specific name is to be preserved, unless such name has previously been employed in the genus to which the species is transferred; and if the author who transfers such species alters the name, it may be restored by any subsequent author.

IV. That a varietal name be treated as equal in rank to a specific name, in its relations as a homonym and in the transfer of species and varieties from one genus to another.

BOTANICAL GAZETTE

OCTOBER, 1892.

A preliminary comparison of the hepatic flora of boreal and sub-boreal regions.[1]

LUCIEN M. UNDERWOOD.

The distribution of the hepatics of boreal and sub-boreal regions is becoming sufficiently understood to form some sort of a basis for comparative study, and while we yet have much to learn even of the best studied region of northern Europe, and still more from the higher latitudes of America and Asia, we can even now profitably gather some statistics and make some comparisons.

While it has long been known that the bryologic flora of the northern portions of both hemispheres was similar, so far as we know no exact comparisons have been instituted, on the hepatic side at least, to determine the nature and extent of this similarity. In the north temperate and arctic zones there are known about 575 species of Hepaticæ. Of these 375 belong to the flora of Europe, 300 to that of America, and perhaps 150 to that of Asia. Of these we may take as representing the boreal and sub-boreal portions, 173 species for northern Europe, 163 for northern America, and ninety-eight species for northern Asia. This will include in Europe, Scotland, North Germany, Scandinavia, and northern Russia, with the islands of Iceland and Spitzbergen; some of the species also extend to the higher Carpathians, the Alps and the Pyrenees; for America the colder regions from Newfoundland and Labrador to British Columbia and Alaska, including Greenland (whence some sixty species are known); and extending southward along the higher Appalachians as far as the Carolinas, and probably southward along the present *incognita* of the Rockies and the Sierras; for Asia it includes only the coast-line of northern Siberia[2], for of the interior of Siberia, Turk-

[1] Read before Section F, A. A. A. S., Rochester meeting, August, 1892.

[2] Our knowledge of the north Asiatic flora is summarized in the following:—Lindberg and Arnell: Musci Asiæ Borealis. Kongl. Svenska Vet. Akad. Handl. No. 5 (1889). Mitten: An enumeration of all the species of Musci and Hepaticæ recorded from Japan. Trans. Linn. Soc. 2nd Ser. III. 153-206 (1891).

estan, the most of the Mongolian empire, and Thibet to the north slopes of the Himalayas, our knowledge of the hepatic flora is almost an absolute blank.

For our knowledge of the hepatic flora of boreal America we are indebted largely to the collections of two men, John Macoun, who has collected hepatics since 1866 from Nova Scotia to Little Slave Lake and the confines of Alaska, and Rev. Arthur E. Waghorne, who has collected in recent years in Newfoundland and Labrador. From these two collectors alone we have examined over a thousand packets of hepatics during the past three years. In addition we have the results of the labors of Mr. Pearson[1] on Macoun's earlier collections, and the still earlier collections of Drummond, which were worked up by Taylor whose collection at Cambridge furnishes considerable material bearing on the northern species. The Greenland flora has been summarized by the Danish botanists[2], and several collectors (Krause brothers, J. M. Macoun, Miss Cooley, and others) have taken scattering species in Alaska. The bryology of that region, however, demands much more thorough exploration than has hitherto been given it.

The difficulties arising in the systematic study of these northern collections are fourfold:—

1. The similarity of the American to the European flora, rendering necessary a thorough familiarity with all the European species, varieties and forms.

2. The undue refinement of specific distinctions made by recent European hepaticologists especially in the genera Scapania, Cephalozia, Marsupella, Nardia and Jungermania.

3. The confusion introduced by periodic upheavals of nomenclature, notably by Lindberg among the Scandinavian species, which very largely interlace with those of America.

4. Absence of many types and inaccessibility of most that are in existence; combined with this are the conflicting opinions of European authorities regarding the autonomy and identity of many species, and the misleading character of many European exsiccatae.

In spite of these difficulties, we are gradually getting order out of chaos, and hope in time to have the American forms satisfactorily co-ordinated with the European.

[1] List of Canadian Hepaticæ, 1890.

[2] Lange: Hepaticæ in Meddelelser om Grønland, Tredie Hefte, pp. 407-421 (1887).

As most of this paper is necessarily statistical, we present only some of the leading features of a detailed study of the three floras:—

1. Of the 214 boreal and sub-boreal species, eighty per cent. are European, seventy-six per cent. are American, and forty-six per cent. are Asiatic. While the larger part of the species of Europe and America have been brought to light, it is quite likely that the smaller number known from the more extensive Asiatic continent is due to the limited exploration of that region.

The distribution by orders can be seen as follows:—

	Species common to Europe, America, Asia.	Species common to Europe and America.	Species common to Europe and Asia.	Species common to America and Asia.	Exclusively European.	Exclusively American.	Exclusively Asiatic.
Ricciaceæ	4	6	5	4	1	1	–
Marchantiaceæ	7	9	10	7	1	1	–
Anthocerotaceæ	–	2	–	–	–	–	–
Jungermaniaceæ	56	112	70	58	24	32	10
Totals	67	129	85	69	26	34	10

Further percentages will appear in the following:—

	Number.	Per cent. of all boreal species.
Circumpolar species	67	31
Species common to Europe and America	119	60
Species common to Europe and Asia	85	39
Species common to Asia and America	69	32
Endemic species of Europe	26	12
" " of America	32	15
" " of Asia	10	4

2. Of the 163 American species, 129 or seventy-eight per cent. are of the European flora; sixty-nine are also Asiatic, while thirty-two or twenty per cent. are endemic.

3. Of the ninety-eight Asiatic species, eighty-five (or eighty-six per cent.) are European, while only ten (ten per cent.) are endemic.

4. Of the 173 European species only twenty-six, or fifteen per cent. are endemic, and this number is likely to be reduced by further exploration of the Asiatic and American floras.

5. 67 species encircle the pole being found in America, Europe and Asia. The percentage of these circumpolar species varies among the orders; while only 30 per cent. of the

boreal and sub-boreal Jungermaniaceae are circumpolar, there is a rise to 44 per cent. in the Ricciaceae, and to 50 per cent. in the Marchantiaceae. No species of Anthoceros are yet reported from Asia, although two species are common in northern Europe and America.

6. As might be expected certain northern hemisphere genera predominate. The genera Jungermania, Scapania, Marsupella and Cephalozia form 41 per cent. of the Hepaticae of all Europe, while the same genera of the northern portions form 46 per cent. of the species. For America the corresponding per cents are twenty-five and thirty-seven. Forty-seven per cent. of the flora of northern Asia is made up of the three genera, Jungermania, Cephalozia and Scapania, the genus Marsupella being strangely absent from that flora. Some comparisons of the larger genera will show more clearly the tendency of certain genera to increase relatively northward:—

	EUROPE.		AMERICA.	
Genera.	Per cent of all species.	Per cent of boreal spec.	Per cent of all species.	Per cent of boreal spec.
Riccia,	6.9	4	6.6	3.7
Aneura,	1.8	4	2	3
Cephalozia,	7	10	4.3	8
Frullania,	1.8	1.7	7	5.5
Jungermania,	19	22	14	19
Lejeunea,	3.7	1.1	7.6	1.9
Marsupella,	7.7	7	1.6	2.4
Nardia,	3.2	2.3	2.6	3
Radula,	3	0.6	3.6	1.8
Scapania,	6.9	6.3	4.3	7.3

While the above table shows the relative increase of such northern genera as Aneura, Cephalozia, Jungermania, Marsupella and Scapania, it also shows the relative decrease of such warm temperate and tropical genera as Riccia, Frullania, Lejeunea and Radula. It also shows the excessive development of Frullania and Lejeunea in America, and that of Cephalozia, Marsupella and Jungermania in Europe.

7. The ninety-eight north Asiatic species are distributed among thirty-seven genera, nineteen of which are monotypic; of these all but three are also American; Peltolepis and Prasanthus are found in Europe but not in America, while Calycularia alone is endemic.

8. Of the boreal species of Europe two genera only are not represented in either America or Asia.[1] These are

[1] Of the European genera of lower latitudes Corsinia, Riella, Tessellina, Acrobolbus, Adelanthus, Calypogea, Gymnoscyphus and Petalophyllum have not been found in America.

Pleurozia and Scalia. All the genera of boreal Ameria are European.[1]

9. The following genera common to Europe and America have not yet appeared in the N. Asiatic flora: Aitonia, Anthoceros, Fossombronia, Herberta, Hygrobiella, Jubula, Liochlaena, Marsupella, Pallavicinia and Pleuroclada.[2]

10. The following comparisons of some of the larger genera are further illustrative:

	EUROPE.			AMERICA.			ASIA.		COMMON TO			
	Total species.	Boreal species.	Endemic.	Total species.	Boreal species.	Endemic.	Total species.	Endemic.	Europe, Asia, America.	Europe, Amer.	Europe, Asia.	Asia, America.
Riccia	26	7	15	20	6	9	5	–	4	10	5	4
Fimbriaria	7	2	4	7	2	4	2	–	2	3	2	2
Anthoceros	5	2	2	12	2	9	–	–	–	3	–	–
Aneura	7	7	2	6	5	1	3	–	3	5	3	3
Cephalozia	27	18	14	13	13	3	9	–	5	9	8	6
Frullania	7	3	4	21	9	18	2	–	1	3	1	1
Jungermania	73	38	41	43	31	17	29	4	19	26	25	19
Lejeunea	14	2	9	23	3	18	–	–	–	5	–	–
Marsupella	29	12	25	5	4	1	–	–	–	4	–	–
Nardia	12	4	7	8	5	4	1	–	–	4	1	–
Plagiochila	7	3	0	7	4	0	2	–	1	3	1	2
Porella	7	4	1	11	6	6	2	1	1	6	1	1
Radula	10	1	9	11	3	10	1	–	1	1	1	1
Scapania	26	11	16	13	12	5	8	–	6	8	8	6

11. The following species are circumpolar, inhabiting America, Asia and Europe.

Riccia bifurca.
crystallina.
fluitans.
glauca.
Asterella hemisphaerica.
Conocephalus conicus.
Fimbriaria fragrans.
pilosa.
Grimaldia fragrans.
(*G. barbifrons.*)
Marchantia polymorpha.
Preissia hemisphaerica.
Aneura latifrons.
palmata.
pinguis.
Anthelia Juratzkana.
Arnellia Fennica.
Bazzania trilobata.
Blasia pusilla.
Blepharostoma trichophyllum.
Cephalozia bicuspidata.
catenulata.
fluitans.
multiflora.
pleniceps.
Chiloscyphus polyanthos.
Diplophyllum taxifolium.
Frullania dilatata.
Geocalyx graveolens.
Gymnomitrium coralloides.

[1] Of American genera of lower latitudes Cryptomitrium and Thallocarpus only are endemic.

[2] Together with Sphaerocarpus, Dumortiera, Lunularia, Targionia and Notothylas from lower latitudes.

Harpanthus Flotovianus.
Jungermania alpestris.
attenuata.
autumnalis.
barbata.
bicrenata.
excisa.
exsecta.
Floerkii.
incisa.
inflata
Kunzeana.
lycopodioides.
minuta.
porphyroleuca.
pumila.
quinquedentata.
saxicola.
sphaerocarpa.
ventricosa.
Kantia trichomanis.
Lepidozia reptans.
Lophocolea heterophylla.
minor.
Mylia anomala.
Odontoschisma denudatum.
Pellia epiphylla.
Plagiochila asplenoides.
Porella platyphylla.
Ptilidium ciliare.
pulcherrimum.
Radula complanata.
Scapania curta.
irrigua.
subalpina.
uliginosa.
umbrosa.
undulata.
—67.

12. The following additional species are common to Europe and America, but have not yet been reported from boreal Asia[1]:

Riccia natans.
sorocarpa.
Clevea hyalina.
Grimaldia rupestris.
Anthoceros laevis.
punctatus.
Aneura multifida.
sinuata.
Anthelia julacea.
Bazzania deflexa.
Cephalozia curvifolia.
dentata.
divaricata.
Lammersiana.
Chandonanthus setiformis.
Diplophyllum albicans.
Dicksoni.
obtusifolium.
Fossombronia Dumortieri.
Frullania fragilifolia.
tamarisci.
Gymnomitrium concinnatum.
obtusum.
Harpanthus scutatus.
Herberta adunca.
Hygrobiella laxifolia.
Jubula Hutchinsiae.
Jungermania capitata.
cordifolia.
Helleriana.
Hornschuchiana.
Michauxii.
riparia.
Kantia arguta.
Lejeunea calcarea.
serpyllifolia.
Lepidozia setacea.
Liochlaena lanceolata.
Lophocolea bidentata.
Marsupella brevissima.—*(M. adusta.)*
emarginata.
sparsifolia.
sphacelata.

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[1] Twenty additional species from lower latitudes are common to Europe and America, bringing the percentage of European species exactly to 50. The remaining species are:

Riccia ciliata.
lamellosa.
nigrella.
tumida.
Sphaerocarpus terrestris.
Fimbriaria elegans.
Lunularia vulgaris.
Targionia hypophylla.
Anthoceros caespiticius.
Fossombronia cristata.
Jungermania laxa.
Lejeunea minutissima.
Rossettiana.
ulicina.
Lophocolea crocata.
Nardia hyalina.
Odontoschisma sphagni.
Pallavicinia Lyellii.
Pellia calycina?
Porella thuja? —20.

Metzgeria conjugata.
furcata.
pubescens.
Mylia Taylori.
Nardia compressa.
crenulata
scalaris.
Pallavicinia Hibernica.
Pellia endiviaefolia.
Plagiochila interrupta.
spinulosa.
Pleuroclada albescens.
islandica.
Porella rivularis.
laevigata.
pinnata.
Scapania compacta.
nemorosa.
Trichocolea tomentella. —62.

13. The following are common to Europe and Asia, but have not yet appeared in American collections:

Riccia minima.
Grimaldia pilosa.
Peltolepis grandis.
Sauteria alpina.
Cephalozia bifida.
connivens.
myriantha.
Jungermania Badenensis.
heterocolpa.
Jungermania Kaurini.
Limprichtii.
longidens.
Wenzelii.
Nardia Breidleri.
Pellia Neesiana.
Prasanthus Suecicus.
Scapania apiculata.
rosacea. —17.

14. The two following are found in Asia and America, but not in Europe:

Cephalozia Macouni.
Plagiochila porelloides.

15. The following boreal and sub-boreal species are found only in Europe:

Riccia Michelii.
Clevea Suecica.
Aneura fuscovirens.
incurvata.
Cephalozia biloba.
Francisci.
integerrima.
Massalongi.
serriflora.
spinigera.
Hygrobiella myriocarpa.
Nevicensis.
Jungermania nardioides.
Jungermania rigida.
Marsupella alpina.
Boeckii.
condensata.
filiformis.
Funckii.
intricata.
obcordata.
varians.
Pallavicinia Blytii.
Pleurozia purpurea.
Scalia Hookeri.
Scapania Spitzbergensis.
—26.

16. The following are the endemic American species:

Riccia lutescens.
Aitonia erythrosperma.
Cephalozia extensa.
minima.
Sullivanti.
Chiloscyphus ascendens.
Diplophyllum argenteum.
Frullania Asagrayana.
Chilcootiensis.
Hallii.
Nisquallensis.
Frullania Oakesiana.
Selwyniana.
Jungermania colpodes.
Gillmani.
Groenlandica.
tesselata.
Vahliana.
Wallrothiana.
Lejeunea Macounii.
Lophocolea Leibergi.
Macounii.

Nardia crenuliformis.
Odontoschisma Macounii.
Porella navicularis.
Ptilidium Californicum.
Radula arctica.
Radula Krausei.
Scapania albescens.
Bolanderi.
glaucocephala.
Oakesii. —32.

17. Last of all are the ten species peculiar to Asia:

Calycularia laxa.
Diplophyllum plicatum.
Frullania Davurica.
Jungermania fertilis.
guttulata.
Jungermania quadriloba.
Sahlbergii.
Lophocolea reflexula.
Mylia verrucosa.
Porella grandiloba.
—10.

De Pauw University, Greencastle, Indiana.

Bacterial investigation of the sea and its floor.[1]

H. L. RUSSELL.

No class of living organisms, animal or vegetable, have been found to be so ubiquitous in their distribution as bacteria, yet strange to say, no especial attention has been paid to the investigation of the marine waters of the globe from a bacteriological standpoint. True it is that the phosphorescent forms of the sea have been more or less thoroughly worked out, and here and there other isolated forms have been described, but the general subject of the bacterial flora of the sea has been left quite untouched. It is not my purpose here to enter into any elaborate discussion of this subject, but only to give a short résumé of work along these lines which I have been carrying out for the past two summers, and also to suggest some problems of interest in connection with this subject.

I fully recognize the futility of attempting to draw any general conclusions from a comparatively small number of tests, but while the results which I have to offer may be regarded as somewhat provisional and will require extended confirmation before they can be accepted as general biological facts, I trust they may possess some interest even in thistenta tive connection.

The results, which I can only briefly summarize here, were obtained at the Zoological Station at Naples, during the

[1] Read before Section F, A. A. A. S., Rochester meeting, August, 1892.

spring and summer of 1891, and at the Marine Biological Laboratory at Wood's Holl, Massachusetts, during the past season.

These widely separated places, so different in many of their conditions, gave exceptional advantages for a comparative study along these lines.

Before detailing the results, I will state, in the briefest possible manner, the methods used in the work. First, in regard to the manner of procuring the material for examination: In securing this for a quantitative bacterial determination, it is necessary that the sample secured should be kept free from contamination, as far as possible, from the time it is originally taken until the growth of the cultures has been completed. To do this with material from surface-soil or air is not especially difficult, but when the material is to be derived from the ocean floor, or at varying depths in the water, the problem of keeping it uncontaminated during its withdrawal is by no means easy. The conditions must be such that the possibilty of contamination during withdrawal will be excluded. The apparatus which is quite universally used to collect samples of deep water for chemical and physical analysis is here of little use as it cannot be previously sterilized, but the following method which has been thoroughly tested for two consecutive seasons and has given most excellent satisfaction is believed to fulfil all the conditions necessary for the work.

It consists of a large sized test tube which is tightly fitted with a rubber cork having a single hole. The opening in the cork is closed by a glass tube which projects about three-quarters of an inch below the lower end of the stopper. The upper part of this small tube is bent at right angles to the long axis of the collecting tube and drawn out at a certain point to a finer caliber, so that it may be quickly sealed in an ordinary flame. The different glass parts are first sterilized by heat, the rubber corks being kept in mercuric solution, then rinsed in sterile water and finally dried on sterile filter paper. These are then tightly fitted together and a partial vacuum produced either by attaching the small tube to a vacuum pump or by expelling a portion of the air by heating the tube with a small amount of hot water or dry heat. The end of the small tube is sealed as the air is expelled. The vacuum tube may then be protected from gradual leakage by coating the cork with a mixture of beeswax and rosin.

To secure the samples of water from any desired depth, these vacuum tubes are attached to a holder by means of an ordinary clamp, the small drawn out glass tube being so arranged that the point of it lies near the connecting line that is fastened to the holder. When the holder with the vacuum tube has been sunk to the desired depth, a lead messenger is sent down over the connecting line and as it is caught on the top of the holder, the small glass tube is broken and the vacuum thus destroyed. The collecting tube fills quickly with water (usually from about two-thirds to three-quarters full) and then the apparatus is quickly hauled up. By virtue of the imprisoned air which can not possibly escape, owing to the projection of the small glass tube below the rubber cork and the rectangular bend in the tube, water is absolutely prevented from entering the tube after the first partial filling.

Cultures are made in the ordinary way by taking 1 cc. of the water after it has been thoroughly shaken up, mixing it with nutrient sea water gelatine and then plating it in Petri dishes instead of using the regulation Koch plate.

The apparatus which has been used to secure material from the sea bottom is theoretically imperfect, i. e., it does not fulfill one of the cardinal bacteriological canons—previous sterilization, but in its practical workings, I am satisfied that it delivers samples of the sea bottom quite uncontaminated from the water layers above. It consists of an ordinary iron tube (a gas pipe serves the purpose admirably) pointed at one end. The other end is fitted by means of a screw with a removable "sleeve," the upper end of which is closed by a valve. As the weighted instrument descends, the water passes through the pipe and as it strikes the sea floor, it is forced into the soil so that it is filled with a compact mass of material. As the instrument is withdrawn, the pressure of the water closes the valve from above so that no water enters the pipe during its withdrawal. The cohesive nature of the ocean slime is quite sufficient, except where pure "live" sand is present, to hold the mud column in the tube.

The mass of mud is removed from the tube by means of a piston rod, and from the center of this mass a known volume of the material is extracted by means of sterilized brass tubes. For this purpose a small sized cork borer is well suited. This known volume of mud is then diluted with a definite volume of sterile water and plated as in the other case. The only

possible chance for contamination is from diffusion which might take place from the sides and lower end of the iron tube. The material is within this for so short a time however, that in so solid and dense a mass as the mud core, this element of error has, I believe, little or no effect.

Attention may now be directed to some of the problems which arise in connection with the investigation of marine bacterial life. Space will only permit a reference to one or two phases of the work, and I can only briefly recapitulate some of the results which have already been obtained.

First, in regard to the presence of bacterial forms in the sea. To determine the bacterial content of the sea, it is necessary for one to secure material outside of the contamination limit from the land. This is of course a varying distance, depending upon the configuration of the shore and other conditions. Fresh water or sewage germs discharged into the sea soon perish on account of the change in their nutritive medium. Of course any quantitative determination of the bacterial contents of the sea must exclude all samples taken within this limit. To my knowledge, the surface water of the sea has not been analyzed bacteriologically at any great distance from land, but samples taken from the coastal line outside of land contamination show that micro-organisms are invariably present in the water. The number per unit of volume varies naturally within certain limits, yet there is on the whole quite a constant average number per unit of measure in these surface waters.

Examination of the *superficial* water layers has always revealed the presence of micro-organisms and it may be interesting to note in this connection the vertical distribution of germ life in the ocean. Are the marine waters peopled *throughout* with bacteria, or is this life confined to the warmer surface waters of the ocean? According to the researches of the Challenger, the marine fauna is separated into a superficial and an abysmal zone, while the intermediate depths are quite deficient in animal life. Analyses of the water at Naples taken at different depths from the surface down to a depth of 3,200 feet showed that bacteria were present in *all* cases. No zonary distribution was to be observed in any case and the intermediate depths as well as the water immediately above the sea floor were found to contain germs in about the same proportion as at the surface.

The usual content of the sea water ranges from 10 to 150 germs per cc., while in exceptional instances the number per unit of volume exceeded this; but the fact that the individuals present were in these cases usually of a single species indicated that the large number was due to a bit of zoogloea rather than active vegetative forms. A comparison of salt with fresh water shows that on the whole bacterial life is less abundant in the sea than in fresh water. The higher temperature of the latter and its proximity to land masses, which are nearly always extremely rich in bacterial organisms, are sufficient to account for this increase.

A bacteriological examination of the sea bottom shows that it, too, is filled with bacteria.

Observation demonstrates that the sea-floor is infinitely richer in germ life than the waters above it. A quantitative examination of the ocean bottom shows a wide variation in its bacterial contents. Just what factors bring about this difference in numbers, I am unable, as yet, definitely to state, but it seems more than probable, that the variable physical character of the sea-flora, the depth at which material is taken, and the influence of temperature are conditions which largely determine the presence of micro-organisms. As might be expected, it will require an extended series of data gathered under similar as well as diverse conditions before the question of distribution can be satisfactorily explained. I shall only attempt to submit certain facts which have been brought out by the work, leaving a definite explanation until more thorough investigation.

At Naples, the investigation of the sea bottom was made from the shore line to a depth of 3,500 feet. At the depth of 150 feet and two miles from land, the sea floor contained from 200,000–300,000 germs per cc. From this number, it fell very rapidly as the depth increased until at the depth of 700 feet only 25,000 germs per cc. were present. From this depth to the deepest point investigated (3,500 feet) the number of germs remained tolerably constant. When these results are graphically represented, they show a marked coincidence with the temperature curve of the Mediterranean at this point. The Mediterranean being a closed basin is not subject to the general oceanic circulation and the temperature of the great mass of its water remains at a constant point. The summer temperature of the surface ranges from 77°–82° F., but this

falls rapidly to 55° F. at a depth of 600 feet, and from this point downward there is no change.

This season's work which has been carried on at Wood's Holl in much more northern and cooler waters shows that the bacterial content of the sea bottom is very much less abundant at this point than in the Mediterranean. In the vicinity of Wood's Holl I was unable to reach any great depth on account of the width of the shallow continental plateau which lies off southern New England and the middle Atlantic states. The number of bacteria per unit of volume was found to be, under similar conditions very much less than at Naples. The germ contents of the slime from Buzzard's Bay averaged from 10,000 to 30,000 germs per cc. This is scarce more than a tithe of what was present in the Mediterranean mud at equal depths.

When we find the mud so much richer in bacteria than the water, the question naturally arises, to what are these results due? Is the ocean bottom merely covered with the spores of the water bacteria that have finished their cycle of development, and then like the remains of the foraminifera slowly sunk to the bottom, or is bacterial life here present in its fullest activity? The answer to these questions may be sought in two ways. Qualitative analysis of the water and the underlying mud will demonstrate whether the species found in the two habitats are analogous or not. If we find the deposit made up entirely of species similar to those found in the water above, even though they may be very much more numerous, it is at least presumptive evidence that the mud owes its bacterial flora to the superimposed water masses. On the contrary, the presence in the mud of species which are *only* to be found in this habitat is evidence that the ocean bottom is filled with forms which are indigenous to this stratum. Qualitative analysis of the Naples mud showed three very prevalent forms which made up at least thirty-five per cent. of the entire bacterial content of the sea slime. These were wholly indigenous and were not found in any cases in the samples of water taken at any depth. A similar result has been reached in the work at Wood's Holl. Two species are most prevalent in the water, together with two or three other forms that are occasional inhabitants. Now the mud contains the two prevalent water forms, it is true, but in addition to this, there is another common form that usually makes up from thirty to fifty per

cent. of the whole number present, and is an indigenous slime bacillus. Besides this species there are two or three other species that are exclusively mud inhabitants although they are by no means so common as the one previously mentioned. I say exclusive, but this is not entirely true, for in two or three cases water cultures made at Wood's Holl have revealed species which had been supposed to be indigenous slime forms. These apparent exceptions can, however, be satisfactorily explained, for they were taken at localities where the tidal currents were strong and there is scarcely any doubt that they were detached from the mud by means of these currents much as the wind detaches bacteria from the soil and carries them about in the air.

The presence of these *indigenous* mud forms necessarily implies that they exist in a vegetative condition, but this can also be experimentally determined. Samples of the mud were taken and treated in the ordinary way in which cultures were prepared. The diluted material was then heated at a temperature sufficiently high to kill all the vegetative forms (80°C) but not enough to destroy the vitality of the spores. Cultures were then immediately made from the heated material and the actual condition of the individuals as they existed in the sample used, could thus be ascertained. These two sets could then be directly compared and the difference in the number of colonies gave the approximate number of vegetative forms actually present in the water or mud. This proportion is often a widely variable one but the analysis of a score or more samples show that the mud bacteria as well as the water forms are in a large degree in a vegetative condition, even under such adverse conditions for their development as those that are found at the bottom of the deep sea.

Mention has only been made so far, of the distribution of marine bacteria in general, but the vertical range of the different species also shows some interesting features. This bathymetrical range, *i. e.* the maximum and minimum depth limits of growth, which each species possesses, varies in different cases.

Great difference in depth means such a marked change in the environment of any single species that one might reason *a priori* that the same species would not be able to adapt itself to such widely different conditions. It is a well authenticated fact that such environments have brought out specific modifications in the faunal life of the sea.

Of the three most common mud forms found at Naples, the maximum depth limit of growth was not attained at the depth of 3500 ft. One of the three species *(Cladothrix intricata)* had nearly disappeared from the cultures, so that it was reasonable to suppose that the bathymetrical range had been almost reached. The other two species were at this depth sufficiently numerous to indicate that the maximum point of development had not been attained. This fact is of especial interest when we consider it in the light of the pressure experiments which have been carried out on bacteria.

Our knowledge of the action of high pressure upon bacterial metabolism is as yet imperfect, but there are several forms which seem to bear an increase of pressure of upwards of 100 atmospheres without material change.

A comparative study of the Mediterranean forms and those found on the New England coast gives an opportunity for a direct comparison from a specific as well as from a numerical standpoint.

The work during the present season has been mainly confined to Buzzard's Bay and Vineyard Sound off the Massachusetts coast, but through the kindness of Prof. Wm. Libbey, Jr., of the U. S. Fish Commission, samples of the mud were obtained about 100 miles from the shore at the depth of 100 fathoms. They were taken by the schooner Grampus on the edge of the great continental platform, which is skirted by the Gulf Stream. The samples are the farthest from land that have ever been analyzed bacteriologically, and give substantial evidence that the ocean bottom is peopled with bacterial life, to at least this distance from shore. Another interesting feature was determined by these analyses. The two prevalent slime species at this point were found to be the same as those taken from near the shore at Woods Holl. This proves a geographical distribution of the common mud species for at least 100 miles from land. A comparison of these forms with those at Naples shows a marked dissimilarity. The number of indigenous forms in the water and mud is not especially large in either case. One of the most interesting species found in the Mediterranean is an endosporous, pseudo-branching form, Cladothrix intricata, which was there quite frequent, but a rare species on the Atlantic coast. This indicates that this species, at least, is quite cosmopolitan in its distribution. Aside

from this form, the other species were quite unlike, although they possess some similar characteristics. The bacteria that are so universally present in sea water and mud seem to be quite peculiar to this habitat. Of course many land and fresh water forms are carried into the sea by drainage, but sooner or later, most of them succumb to the changed conditions of their existence.

With this *introduced* or *adventive* flora, we are not especially concerned, but aside from this, there are these certain well defined species, that seem to be indigenous to this particular habitat. By long residence in salt water, some of them have become so modified, that they grow much more luxuriently upon media made from sea water than upon that which contains only the normal amount of salt. In one of the species isolated at Naples, this specialized saprophytism was as well marked as in the case of certain pathogenic species which are cultivated upon artificial media with only the greatest difficulty. Time will not permit any further discussion of this question of marine microbiology and these disconnected statements will be closed with a few suggestions as to the more important problems presented in this line of work.

Aside from the subject of geographical and vertical distribution of bacterial life and the forces which produce these results, there are various problems which possess a morphological as well as a physiological interest. For example, the inner structure of the bacterial cell—the relation of the karyoplasm to the cytoplasm and the cell membrane—a subject which at the present time in this group is imperfectly understood can, I believe, be better demonstrated with marine species of bacteria than the great majority of other forms. As a rule, the individual cells are relatively large and the protoplasm instead of being homogenous is highly granular.

Besides these morphological questions, there are many of a physiological character, such as the relation of bacteria to phosphorescence; their connection, if any, with deep-sea decomposition; the influence of high pressure incident to depth; and the changes in their oxygen supply, which might be profitably considered.

Much of this class of work can be best done under the auspices of the government, either by the Fish Commission or the Coast Survey, as these departments are already provided with the necessary outfit of vessels fitted with suitable dredg-

ing apparatus, etc., for deep sea work. Unfortunately, the methods of work preclude the use of preserved material, as this subject can only be prosecuted by means of culture work. Not only would such a department of research upon our scientific exploring expeditions add greatly to our knowledge of bacterial life, but the lower forms of fungi could be investigated as well.

University of Chicago.

A peculiar case of plant dissemination.

EDWARD L. BERTHOUD.

Studying lately with intense interest "Island Life," by Alfred Russell Wallace, and his remarks upon the dissemination of plant life everywhere, both on continents and islands, it brought to my mind what many years ago I had observed during a long residence, and numberless scouts, excursions, surveys and pleasure trips I have made in the region included between the Missouri river and Great Salt Lake, and from the $34\frac{1}{2}°$ N. latitude to that of Eau qui Court in Dakota, and Sun river in Montana.

As these may be of interest and some value in the determinations of geographical botany, and have a bearing in the elucidation of geological botany, I will briefly give the more salient points of these observations. I can show to some extent that between the Missouri river and the Rocky mountains, the American buffalo has been an efficient agent in plant dissemination. Until within twenty-six years the buffalo was known to range from Peace river and Athabaska valley to central Texas. Very much as our Indian tribes are known to do, the buffalo uniformly followed trails in their annual migrations from north to south, or *vice versa*, very rarely deviating from them, whether across prairie or woods, or over spurs of the Rocky mountain range, on their migrations through South, Middle, North Park and Laramie Plains. And when in the spring the former countless herds from Texas moved north across the Arkansas, Smoky Hill, Republican and Platte rivers, the same trails were used, the same river fords crossed, and, following the best ground for their migrations, their sagacity or instinct (if you choose so to call their

inherited faculty) made them follow trails over the lowest and best divides between streams.

When following large herds in Nebraska, Kansas, Colorado, Indian Nation and Texas, we have seen these trails in soft rich ground worn down five or six feet deep, thirty or forty feet wide, as well defined as a graded wagon road.

We have spoken of their migration only in a sense restricted to our personal knowledge in the region we have already described. Yet from the best information we can get we find that this same yearly change of locality occurred in northern Idaho, Montana and Dakota, and north of the Black Hills, not so much from scarcity of forage, as the necessity of shelter from the winter snows and blizzards of the upper Missouri and Yellowstone prairies; while in British America, according to the accounts of Franklin, Richardson, and also Messrs. Milton and Cheadle for the Saskatchewan and upper Athabaska valleys, the buffalo were driven by snow and intense cold from the open country into the timbered valleys, and forests west of the open plains and in the Athabaska region.

In the spring the general movement of the buffalo was north into Nebraska, Colorado, Wyoming and Kansas across the Arkansas river, then north to lat. 44° or even farther, and largely governed by the more or less abundance of grass and water, but as early as May vast herds were already in the Platte valley, invading the vast prairies of Dakota and Nebraska. In the fall the returning herds would be seen in October in the Platte valley, or even as far as the Arkansas.

These points explained and shown, we will now explain in what manner this bears on the question of the dissemination and intermingling of plant life within the limits given in this discussion.

The American buffalo, a good deal as their congeners in the eastern hemisphere, delight in rolling and plowing up with their horns the soft, muddy soil of the prairies, or of any bluff bank; rolling around they formed countless numbers of shallow depressions, circular in shape, very often retaining rain water for days, which were familiarly known as "buffalo wallows."

So that along deep, wide trails, and in the wallows, the sod being worn away, and the soil loosened and trampled up, large areas would be conspicuous by nourishing and perpetuating a new growth of plant life, introduced, generally or altogether foreign to a prairie country, and of such species as found these conditions favoring their growth.

We would find there Plantago (2 species), Asclepias Syriaca, Trifolium, Thlaspi, Amarantus, Chenopodium album, Martynia proboscidea, Sinapis, Portulaca, Lippia cuneifolia, and the grasses, such as Cenchrus, Stipa, Setaria, Elymus, Dactylis, Deschampsia, Panicum Crus-galli, Euphorbia, Glycyrrhiza, Epilobium.

We could add to this list Helianthus, but as this plant is firmly established as a native to the soil of this whole region, and universally appears along old roads and in all the valleys, its dissemination seems to be largely independent of artificial dissemination, and dependent for its spread solely on the bared condition of the ground when sodless. We have so far given what annuals or biennials are found in the artificial denudations made by the buffalo. To these we can add Rhus glabra, and a plum called "sand plum," a low spreading bush, two feet or less in height, abundant south of the Arkansas and in the Indian Nation. It was found by me near old buffalo trails in north Colorado, up to near North Platte in Wyoming. The same can be said of Rhus glabra, which in Colorado, at the foot of our Rocky Mountains, has been introduced since 1860; and found in Wyoming as far north as the forty-second parallel: the plum might be, perhaps, the Prunnus pumila, but may be only a variety of P. Chicasa, though I can hardly admit this as probable.

Now how do the buffalo distribute all these plants and shrubs, which so fix themselves in the places artificially formed in this whole vast region? An inspection of the enormous pad of hair four to twelve inches long that clothes the whole front of the buffalo's head from the root of the horns nearly to the muzzle, besides the dense long hair that clothes the legs and breast of the animal, reveals masses of hair, matted with mud, seeds, twigs cactus fronds and roots.

When examining the heads of dead buffalo I repeatedly noticed, matted in the long hair of the forehead, the woody two-tined capsules of Martynia with the seeds of the plant; also seeds of Bidens, Glycyrrhiza, Stipa, Setaria, Elymus, the seeds and pappus of Helianthus and other unknown Compositæ, hispid twigs of Euphorbia, and seeds of some species of Rhus, perhaps R. trilobata very common in Colorado, seeds of Obione canescens, and seeds either of Amarantus or Chenopodium. The pad altogether made up an ambulant Wardian case.

Now such a pad of hair (overlooking the breast and legs of the animal) matted as we have said, and daily rubbed in earth banks or wallows, is as good an apparatus for artificial dissemination as could be imagined when we consider the range and habits of the animal. Given a herd of ten thousand buffaloes roving from the Red River of Texas to northern Nebraska and Montana, we can justly imagine that the seeds of southern species of plant and shrub life would in time be left at intermediate points most favorable to their growth, while the returning herds in the fall and winter would be laden in the same manner with northern plant seeds to be in their turn dropped or left many miles south of their former habitat. Nor is it necessary that any one species of the plants should be conceived as forcibly carried from Texas to Montana by one migration; on the contrary taking the case of Martynia, a seed brought from Red river is dropped in a favorable spot on the Arkansas in some trail or wallow. There it matures seeds mayhap for years; some of them are again entangled in the forehead or the front woolly hairs of a buffalo on its neck or fore legs and are finally dropped by chance on the Smoky Hill or Republican The same actions may recur, and the plant seeds be carried into the next valley or to the next prairie divide, so that in course of time it is not at all improbable that any one species of plant would finally reach the uttermost northern limit of the buffalo's northern range, the plant being, as it were, slowly acclimated by the successive transference from age to age in its continued dissemination. What we argue in relation to the Martynia, can equally apply to any plant or shrub seed, varying in its northward or southward progression just in proportion to its adaptability to withstand heat or cold, drouth or moisture, and its adaptation to extraneous transportation.

Now, if we turn to Richardson's Appendix to his Arctic expedition we find that he gathered *Opuntia glomerata* at the Lake of the Woods, while others have found it since near Lake Winnipeg. The occurrence of such a southern type of plant about latitude 50° to 51° north, we believe was largely due to a progressive dissemination by the buffalo, not only by seed, but also by direct conveyance of fronds and roots. This transfer we conceive highly probable, as well as that of many other plants and shrubs that range into British America from as far south as latitude 35° and 36°. We are certain

the sand plum has advanced from the Arkansas river into northern Colorado and Wyoming, since in the scope of the buffalo country extending from the forks of Platte river to the Rocky Mountains, I have found it only where the main buffalo trails formerly existed. Rhus glabra is, however, such a cosmopolitan shrub, that its dissemination north may be as justly ascribed to recent settlement as to the artificial dissemination we have advocated.

Again, if the fossil sequoias, figs, magnolias, oaks, palms, liquidambars, cycads, salisburias, laurels, persimmons, cinnamonums, aralias, sassafras and many other semi-tropical or south temperate trees and shrubs now found in the Cretaceous, Eocene and Miocene beds of Colorado, were derived from the Arctic regions originally; and if their modified descendants now found extant from the Missouri river south to the Mexican gulf are their living representatives, then it is quite remarkable that no representatives of the cactus family occur either in Greenland strata or in the same formations in Colorado. Their total absence also from the Pliocene strata of South Park, so rich in Sequoia, Glyptostrobus, Myrica, Rhus, Sapindus, Ficus, Planera, Cesalpinus, Acacia, Zizyphus, Ilex, etc., though really only negative evidence of their non-existence there, is strongly corroborated by the fact that the Opuntia is a plant that avoids damp, densely timbered surfaces. It delights in dry, stony, sandy soils, and requires but little water the whole year round. The vegetation of the Cretaceous, Miocene, Eocene and Pliocene strata in Colorado predicates the presence of rich, damp soils, either of valleys or low humid plains. Although the presence of fossil cacti has never yet been proven in any of the formations we are now considering, the fleshy nature of the fronds of Opuntia would naturally be very unfavorable to fossilization; but its abundant seeds of a very hard consistence, would be unusually well fitted for preservation, for we find to-day in the strata under consideration fossil nuts of Fagus, Corylus, Carya, Diospyros and a species of plum, besides palm nuts, fern fronds with sporangia complete, seeds of grasses and carices, also of elm and Planera.

The reader may ask what has all this to do with the question of "buffalo pads." The answer is simple enough. We think we prove very strongly by this that the cacti that extend from southern latitudes to Lake Winnipeg, are colonies that in the

course of ages have been gradually acclimated by artificial dissemination, and not the fragments of a flora derived from Arctic regions. Granting this, then the same method would apply to Clematis Virginiana, Negundo aceroides, Ampelopsis quinquefolia, Prunus (Cerasus) serotina, Cornus, Shepherdia argentea, Sambucus pubens, Hypopitys; all found according to Richardson far north in the British possessions, within the old buffalo range, but also common as far south as latitude 35° north.

Golden, Colorado.

Notes on certain species of Erythronium.

E. B. KNERR.

Perhaps there is no more interesting genus of plants among Liliaceæ than Erythronium. The species are the first of the order to appear in the spring and in point of beauty are second to none. Besides, there are features of propagation quite as puzzling and wonderful as any to be found.

Of the three species to be mentioned *E. Americanum* Ker. is the most common in the eastern states, *E. albidum* Nutt. in the central and western states to Kansas and Nebraska, while *E. mesochoreum* Knerr belongs to the states of the lower Missouri valley. All three species present two kinds of plants: a flowering two-leaved and a flowerless one-leaved form, both of which arise from underground corms. In the flowering forms these corms, or rather fleshy bulbs, consist of a series of corms arranged somewhat spirally one within the other, sometimes as many as four or five in number, the youngest innermost, each corm producing its plant in succession a year apart and beginning with the oldest and outermost. Sometimes, however, in E. mesochoreum and E. Americanum it happens that two and even three of these corms may develop at once, producing as many leafy scapes apparently from the same root, when ordinarily but one would be expected. As yet I have never noticed this in E. albidum.

The sterile forms (one-leaved) both of E. Americanum and E. albidum, and sometimes the flowering, send out underground off-shoots or rhizomes which produce at their extremities new corms destined to furnish the plants of the next season. In the two species, however, there is this difference:

E. albidum usually sends out but two (though sometimes specimens are found with but one such rhizome), a strong vigorous one and a second that is weaker and smaller. In E. Americanum the number is usually from three to five, successively diminishing in size, all more or less coiled and twisted. In E. albidum they are much straighter and somewhat deeper rooted. E. mesochoreum never produces such rhizomes, so far as we have observed, either in the one-leaved or in the two-leaved forms.

Herein we readily find an explanation for the multitude of the one-leaved forms of both E. albidum and E. Americanum wherever they occur; for in the case of the first species where this year was but one plant, next year will be two; and in the case of the second species even a greater number will appear, a plant for each new rhizome. Thus it is that whole slopes of shaded ravines become carpeted with these beautifully mottled leaves. Only one here and there of the thousands is destined to develop a corm without offshoots, which in a season or two may send up a flowering scape to produce seed and propagate its species sexually.

Right here arises an interesting question: What selective power is it that determines the one in the ten thousand, which is thus to reach fruiting?

We are reminded that this same question arises in other branches of biology wherever propagation is secured by both the asexual and the sexual processes. The reply usually given is that the conditions lie in the food supply, a very plausible answer for the most part, but we seriously doubt its sufficiency.

As such rhizomes producing corms at their extremities are entirely wanting in E. mesochoreum, sterile forms in this species are comparatively rare, and those that do occur are seedlings soon to become fertile flowering forms. Hence it is that where this plant is established there is no lack of bloom in the flowering season.

The leaves of E. albidum and E. Americanum are very similar in appearance, being both very conspicuously mottled with various shades of green and purple, especially in the early part of their blooming season; but those of the latter species are usually broader and flatter than those of the former. We have noticed that this mottling disappears to a great extent, especially in E. albidum, as the season advances, the color be-

coming almost a uniform bright green and then fading to yellow as the leaves wither. But as yet we have sought in vain for unmottled forms of *young* E. albidum mentioned in the botanies. The third species, E. mesochoreum is never mottled, especially when young, though we have found a few specimens that showed a faint mottling in lighter shades of green when the season was much advanced. The leaves of this species are also much narrower and longer than those of either the other two, being mostly linear-lanceolate, and indeed even linear in some specimens.

The habitat of these plants is also characteristic, E. albidum and E. Americanum preferring deep shaded ravines and moist meadows, while E. mesochoreum takes to the hill-tops and the north facing slopes whether wooded, or open and covered with grass.

The color of the sepals is also distinctive, E. Americanum being yellow with purple dots at the base, E. albidum white tinged with pink, and E. mesochoreum also white, but tinged with lavender or blue. The perianth of the last is usually much longer than that of E. albidum and is not so much reflexed in the bright sunshine.

The stigmas of E. Americanum are peculiar, being massed into a club-shaped body; those of E. albidum are quite divergent and somewhat recurved; while in E. mesochoreum they are more slender and decidedly recurved. The capsules of this last species are also much larger and longer than those of either the other two and everything indicates that the seed is also more vigorous, a fact naturally to be expected seeing that this form propagates rather sparingly by the bulb.

Midland College, Atchison, Kansas.

BRIEFER ARTICLES.

Notes upon Daucus Carota.[1]—The early introduction of this plant, from its European soil and environments, and its present wide distribution, and ready adaptation to new conditions make it a good type from which to expect those variations of habit, structure, etc., which usually attend the transplanting of a new organism with new conditions. Records of the numerous changes which it has undergone

[1]Read before Section F, A. A. A. S., Rochester meeting, August, 1892.

prove that it is no exception to the general laws of variation. Leaving out of all account the extended variation among the cultivated varieties which are quite as marked as among others of its congeners, my purpose in this note is to call attention to the range of variations to be found in the weed in a state of nature. This tendency is quite marked, and has often been noted. One of the more common and constant phases of variability is to be fouud in the floral umbel. The presence of a single, central flower, springing from the immediate center of the disk, and of a deep purple color, in distinction from the generally pure white of the entire umbel, is a feature that has been known for some time, though I am not aware that any record has appeared in any recent literature.

Another feature nearly as general and constant is the presence of a peripheral circle of larger flowers, mostly sterile and radial, though this is not universally the case, and for this reason, as probably in the preceding case no special record has been made of the fact.

During the present summer I have observed certain other variant phases which seem to be somewhat new, as a very considerable extent of inquiry among leading botanists has failed to elicit any corresponding observations. The features to which reference is here made are two. *First:* The extension of the unique colored and sterile features of the central flower to the whole central umbelet. This I have noted in quite a large number of cases. *Second:* The implication of the entire umbel in the coloration. This feature was by no means as general as the last, but was quite marked in many individuals. My first thought upon observing it somewhat casually was that it was probably due to the same cause which leads to the assumption of purplish hues by many white flowers as they age toward withering. Subsequent observations, however, showed that this could not be the case; as in those plants exhibiting the phenomenon at all, it was quite as marked in the earlier phase of flowering as at any other. This, together with the observed tendency of the central purple flower to involve the whole central umbelet in its peculiar color, renders very strong the conviction that it is a case of variation, which in time may become quite general and permanent.

My first observations on these points were made in the vicinity of Cold Spring, L. I., but have subsequently been verified upon specimens in this vicinity, and I doubt not may be found occasionally in many localities, though I had not noticed them at all in the middle western states.

It is quite remarkable that notwithstanding these and other features of variation, the divergence has not been sufficiently marked or con-

stant in any one direction to give rise to new species, or even to well marked varieties.—CHARLES W. HARGITT, *Syracuse University, Syracuse, N. Y.*

Cross and self-fertilization.—In a series of experiments, still in progress at this college, on the fertilization of the common petunia, the following results were obtained from the first generation.

One dozen petunias of equal vigor were selected from the greenhouse cuttings, and put into pots of equal size, and subjected to exactly the same conditions. About half of the plants were the dull purple variety, nearly the original type, while the others were variegated and somewhat modified. Each blossom was very carefully excluded from accidental fertilization, by being tied in a paper bag, or by having the corolla tied together tightly until the capsule had begun to develop.

There were three series of experiments. The blossoms of series I were self-fertilized; those in series II were fertilized from other blossoms on the same plant; and in series III they were fertilized from other plants.

Series I bore capsules averaging 1.8 centigrams in weight, series II bore capsules averaging 2.7 cgms. in weight, and series III bore capsules averaging 4.1 cgms.

In series I and III, the seeds of the plain purple and the variegated specimens were weighed separately, showing the variegated to be lighter. In series I the purple weighed 0.7 cgm. more than the variegated in the same series. In series III the purple bore capsules 0.2 cgm. heavier than the variegated in the same series.

It was also noted that many more capsules in series III developed and ripened perfectly than in either series I or II; while series I ripened the smallest percentage of capsules. Owing to various accidents no definite figures could be obtained to show the exact proportions.

Thus it may be inferred that even in the first generation the deteriorating effects of self- fertilization are plainly shown; and also the tendency of much modified plants to decline in vigor and productiveness.

Darwin, in his book on cross and self-fertilized plants, page 189, says: "In crossing six blossoms, there were six seed capsules produced, weighing 4.44 grains; while six others were self-fertilized, producing only three capsules weighing but 1.49 grains."

This experiment is interesting from the fact that it agrees with Darwin's very similar experiment on the same plants.—MINNIE REED, *State Agricultural College, Manhattan, Kas.*

CURRENT LITERATURE.

Last volume of a great work.[1]

The task of collecting and issuing in uniform manner all the specific descriptions of fungi ever published, although requiring prodigious labor, has been accomplished by the author of the Sylloge Fungorum in a remarkably short time, and the final volume now lies before us. The ten volumes of the work contain about forty thousand species. How many of these names are synonyms is the part of the monographer and special student to determine. Excellent judgment has been shown throughout in the compilation, and the work will not only be a monument to the perseverance of the author, but of inestimable and lasting service to mycologists.

The present volume does not differ essentially in its make up from the preceding, except in possessing a universal index to the cohorts, families, genera and their synonyms of the full ten volumes. The series closes most appropriately with an enumeration of fossil fungi, embracing 331 numbers, compiled by Dr. A. Meschinelli.

Although this is the last volume of the work as projected, Dr. Saccardo offers to issue addenda, if authors will kindly continue to send him their publications. He states that at the time this last volume came from the press (June, 1892,) some fifteen hundred species, *incredibile dictu*, had already come in, too late to be included. Such evidence of activity in the collection and study of fungi indicates how highly serviceable such addenda must be to all working botanists.

The flora of the Dakota group.[2]

This invaluable contribution to the fossil flora of North America was the last work of Leo Lesquereux, who died in the fall of 1889. It is composed of a vast number of leaf-drawings, identified and named by the deceased author, and portrays the forests that once existed in this country. At the same time it shows the broad range of this scientist's work, whose childhood was spent among rocks, trees and flowers in the heart of Switzerland. From these early influences Lesquereux naturally turned in time to the study of botany, to which he devoted the greater part of his life. In the year 1848 he came to

[1] SACCARDO, P. A.—Sylloge fungorum omnium hucusque cognitorum. Vol. x, supplementum universale; Pars II, Discomyceteæ—Hyphomyceteæ, additi sunt fungi fossiles auctore Doct. A. Meschinelli. Roy. 8 vo, pp. 964. Patavii, 1892. —Francs 48.

[2] LEO LESQUEREUX.—The flora of the Dakota group, a posthumous work, edited by F. H. Knowlton, U. S., Geol. Survey. 256 pp., 66 plates. Washington, 1891.

America to become our foremost paleobotanist. His great enthusiasm soon made him familiar with our flora, and we need only to look at the work he has left us to get an idea of his talent and indomitable energy. His last, as well as his previous works are well fitted to stimulate our paleobotanists. As it will be impossible to give a complete review of this voluminous work, we point out a few of its characteristic features, as shown in the original way, by the author himself.

How full of interest, for instance, are the figured leaves of *Liriodendron*, illustrating the transition to ancestors with deeply lobed or even pinnatifid leaves, sometimes of gigantic size, but with the characteristic truncate apex, until another form appears with the terminal lobe preserved as in *L. semialatum*. The comparison of these very different types might seem hazardous, did the carefully drawn figures not show a striking accordance. We note one exception only: the nervation of the leaf (plate XXIX, fig. 3) appears somewhat different from a true *Liriodendron*. Comparing the genus *Sassafras*. we find a large, five-lobed leaf with margin entire (*S. dissectum*), while *S. cretaceum* var. *grossidentatum* and *S. papillosum* show similarly lobed leaves, but with dentate margins. These last forms seem, however, hardly to belong to the genus *Sassafras;* the leaf figured on plate VI, fig. 7, agrees in most respects with a leaf of a *Platanus*, closely related to *P. occidentalis*. We wonder also why the author did not consider the leaves of *Sassafras dissectum* and of *S. subintegrifolium* (plate XIV, figs 1 and 2) as one species, since these two forms are easily recognized in our recent *S. officinale*. We find, too, a number of leaves of Heer's *Betulites* united into one species by Lesquereux, who gives in the text a most valuable account of the variation of leaves on this tree, and calls attention to the fact, that if these leaves had been found separately, at different times and in different localities, they might have been referred to a number of species.

There is, altogether, in this work — not only in the text, but also in the numerous illustrations — abundant material for further studies. Besides describing and enumerating the species of the Dakota group, as far as it is known at the present time, including ferns, cycads, conifers and phanerogams to the number of 460 species, the author gives an analysis of the entire flora. A general sketch of this highly interesting flora is given with critical notes upon the types occurring there, for instance of *Liriodendron*, *Sassafras*, *Quercus*, *Ficus* and many others. The study of these plants has led to the conclusion "that the flora of North America is not at the present epoch, and has not been in past geological times, composed of foreign elements brought to this continent by migration, but that it is indigenous; its types are native,

and the diversity of their representatives has been produced by physical influences. The affinities, therefore, or the relation of their modification or derived forms can not be looked for in the vegetation of distant countries."

As the work is left by the author, although unfinished, it commends itself, and the author's name will always be remembered with admiration and gratitude. But we are unable to leave his work without a few remarks about the manner in which it has been edited.

In looking through this book, we are surprised at the number of errors, apparently of carelessness, such as mis-spelling, incorrect citations, omission of figures, misleading terms, etc. The editor seems not to have understood the responsibility of editing a posthumous work. The best method of editing a posthumous work is, undoubtedly, to carry it out in the same spirit in which it was started, taking all facts into consideration. It must not be forgotten that Lesquereux was an old man, who, in the later years of his life, became unable to keep informed as to recent publications, and that his views in some respects belonged to past times. Then, too, there are many things that are admissible in a manuscript, written as the thought first comes to us, and pleasing for the time to the fancy, which should be omitted in print. We dare say, that in its present form, this work would never have been published by the author. The reader will readily observe the wide gap between the genial and elegant work of Lesquereux, and the lack of care and taste in the present edition.

Although it is as unpleasant a task to criticise a posthumous work as it is delicate to edit it, we must note some of the deficiencies in the edition. The plates, which form the most important part, and which should have been a guide to further studies, are poorly arranged. The genera ought to have been so placed as not to require one to look over a large number of plates, widely separated from each other, to find the species of each genus. This is the case, for instance, with *Protophyllum*, *Ficus*, *Sassafras* and most of the large genera. It would have been an easy matter to arrange them in good order. Several of the figures are designated by numbers so distant from the respective illustrations that it is hard to tell to which figure the numbers belong. Some of the illustrations are not named at all, and others are not numbered. The spelling of names is inconsistent in a great many instances: we have both *grossi-* and *grosse-dentatum*, *cissioides* and *cissoides*, besides numerous others. Often the specific name is of the wrong gender as: *Fagus orbiculatum*, *Sassafras primiginea*, *S. artica*, *S. Pfaffiana*, etc. The descriptive part contains some misleading phrases; e. g.: "dots like the impression of basilar points of hairs"

(p. 98), "a bunch of small pediceled seeds like those of *Carex*" (p. 62). Furthermore there is a too indiscriminate use of terms: e. g., basal, basilar and basil — the last of which is the name of a plant, but is written in the manuscript as an abbreviation of basilar. In the descriptions of the nervation it is a difficult task to understand the terminology. From *Protophyllum denticulatum* (p. 193) we cite the following: "median nerve," "lateral primaries supra-basilar," "secondaries with their divisions," and finally, "nervilles!" The nerves figure under several names: veinlets, nervilles, etc., which are not technically correct. On page 92 we learn that "the nerves are attached to each other." Again it is remarkable that such an expression could escape the editor's attention as this from p. 243: "*Diospyros Virginiana* being the only species remaining in the present North American flora." Such mistakes might easily have been corrected, but we are sorry to say that these and many others have been allowed to pass by the editor whose duty it would seem to have been to correct them.

We regret that this valuable work of Lesquereux has not met with a more satisfactory treatment as to correctness and form. The spirit and skill of the author has failed to find in the editor due appreciation and sufficient painstaking for so important a work.—TH. HOLM.

The Minnesota Catalogue.

IN THE PRESENT confusion of ideas with regard to the larger groupings of plants it is as well, perhaps, for authors of local lists as well as more extended manuals to try to express our present knowledge of plant affinities. Such an attempt is now before us in Professor Conway MacMillan's introduction to "the Metaspermæ of the Minnesota valley." This introduction, reprinted in advance, is intended to be a statement of the principles and classification to be followed in the forthcoming enumeration. The principles enunciated are those familiar to all who consider the subject of nomenclature, which is now in a fair way to be so happily settled. We much regret that so sprightly a young author should see fit to include in this part of his very readable pages any insinuations as to unworthy motives governing those who are counted as conservatives in this matter. Differences of opinion there must always be, but courtesy demands that a man shall be taken to be honest in any public expression of his views. As to the proposed groupings: two great divisions are used, Protophyta and Metaphyta, based upon the absence and presence of sexuality. Metaphyta are further subdivided into Gamophyta and Sporophyta, dependent upon the development or not of a distinct sporophyte. Sporophyta are then subdivided into Thallophyta, Archegoniatæ, and Metaspermæ, whose names practically describe their limitations, the last named including

angiosperms. In grouping the Metaspermæ Treub's conclusions from the study of Casuarina are accepted, and the groups Chalazagameæ and Porogameæ adopted, dependent upon the absence or presence of a micropylar canal. The Porogameæ contain monocotyledons and dicotyledons; the latter being further subdivided into Archichlamydeæ and Metachlamydeæ, the former being a combination of Polypetaleæ and Apetalæ, the latter the Gamopetalæ.

Special attention is called to the definitions of Metaspermæ and Archispermæ (Gymnospermæ), which includes our knowledge of the difference in the origin of the so-called "endosperm" in the two cases and the still somewhat obscure notions as to the sexual origin of the angiospermous "endosperm." Our present knowledge and theory with reference to these very important but very recondite distinctions are well and compactly put, but we may be pardoned the question whether the language is not too severely technical to be addressed "not to any coterie of *savants* in some special line of science, but to the general public of Minnesota." Professor MacMillan has undertaken a very interesting piece of work, and with a vigor of style and freedom from restraint that will surely bring useful results.

Minor Notices.

DR. N. L. BRITTON has published a synoptical list, including synonymy, range, and descriptions of new species and varieties of the species of Scirpus and Rhynchospora occurring in North America.[1] Of Scirpus 36 species are enumerated, including the new *S. Peckii* of N. Y. and Conn. Rhynchospora presents sixty species, sixteen of which are Mexican, West Indian, and South American.

DR. TRELEASE has long been studying our Yuccas, a sort of heritage from Dr. Engelmann, intensified by his own interest in all that relates to pollination. The story of Yucca, told by Dr. Engelmann, Professor Riley, and Dr. Trelease, is a part of the pyrotechnics of our science, so wonderful that seeing is almost necessary to believing. Dr. Trelease had intended to give to the public a summary of the whole subject, together with the results of his recent studies both in the Botanical Garden and in the native haunts of Yucca, but Professor Riley has undertaken the work from the standpoint of Pronuba. We have left, however, in the reprint before us[2], a synoptical list of our

[1] BRITTON, N. L.—A list of the species of the genera Scirpus and Rhynchospora occurring in North America. Contrib. Herb. Columbia Coll. no. 26. Reprinted from Trans. N. Y. Acad. Sci. XI, pp. 74-94.

[2] TRELEASE, WILLIAM.—Detail illustrations of Yucca and description of Agave Engélmanni. From the 3d Ann. Rep. of the Mo. Bot. Garden, pp. 159-168 with 25 full page plates. Issued May 28, 1892.

Yuccas and illustrations of thirteen of the species. Eleven plates are devoted to the display of such characters as enter into the delimitation of species, while twelve reproductions of photographs show finely the facies of the different species. A new Agave, *A. Engelmanni*, is also described and figured.

OPEN LETTERS.

Who are biologists?

Botanists will feel grateful to Prof. MacMillan for his vigorous protests against the present unfortunate attitude assumed by zoologists in regard to the position of botany as one of the biological sciences. This question is one which vexes us here as well as elsewhere, but since my connection with the University we have been insisting upon a recognition—by our students at least—of the place in biological studies to which botany is entitled, and I am glad to say that there is a disposition among some of the best of our zoologists here, to grant what we claim in this respect. The question is an important one in many ways, and it has occurred to me more than once, that it would be a proper one for action by the Botanical Club in the first instance, and then, if possible, by the Biological Section of the A. A. A. S. Certainly the botanists of the United States and Canada are a sufficiently numerous body to make any serious representations from them of value. Were action taken by them in this case, and their position firmly maintained, I think it would have considerable weight in settling once for all what is a most unnecessary annoyance and injustice to an important profession.

The Madison meeting is to be an important one. At it will be gathered, it is hoped, not only all our own best men, but a number of representative men from abroad. There could be no more fitting opportunity to bring this question forward and have it freely discussed, and the present is none too early to suggest such a movement.—D. P. PENHALLOW, *McGill University, Montreal.*

Variations of the strawberry leaf.

The article of Mrs. Kellerman in the August number of the GAZETTE suggests the following: In May, 1889, I noticed upon specimens of *Fragaria* which were brought into the laboratory, additional fourth and fifth leaflets upon the petiole below the normal leaflets. Turning to Bentham and Hooker, Genera Plantarum, under Fragaria, I found "*Folia alterna, 3-foliata, rarissime foliolis paucis lateralibus adjectis pinnata v. 1 v. 5-foliata.*" I determined to search for more examples with a view of ascertaining whether the variation was rare or common in this locality.

In June of the same year, while collecting with half-a-dozen students in the vicinity of Willmette, we all so frequently found the leaves bearing the additional leaflets that we concluded that they could be spoken of as "not uncommon in this locality." October 20, 1890, I found them plentiful at the side of the railroad north of the Ridge viaduct

in a patch of ground which may have been formerly part of a garden. Of fifty leaves taken at random twelve had extra leaflets upon the petiole. Of these twelve, eight had two leaflets, opposite in four cases and alternate in four, and four had single leaflets upon the petiole below the normal leaflets.

May 7th, 1891, I found the extra leaflets abundant in the locality just mentioned and also upon our north campus near the lake shore. When picking at random one in every four or five had the extra one or two leaflets.

In July, 1891, I found in the herbarium of the Natural History Museum, Kensington, London, two specimens of Fragaria Virginiana, one collected in Colorado and the other at Kettle Falls upon the Columbia river, which had the supernumerary lateral leaflets.

My observations tend to the conclusion that in some localities twenty per cent. of the leaves of Fragaria have five leaflets, two of which usually disappear as the season advances leaving the normal trifoliate form.

Mrs. Kellerman, from the variations which she has noted, reasons that the strawberry is developing a quinquefoliate form of leaf. By the flight of his imagination in "The Evolutionist at Large," Grant Allen shows how the "fruit" of the strawberry may have developed from a potentilla; while the facts given above seem to indicate that the plant, so far as the leaves give evidence, is passing or has passed from a pinnate form, not unlike certain potentillas, having five or more leaflets, into a trifoliate form. These observations were made both upon Fragaria Virginiana and upon its variety Illinoensis.—C. B. ATWELL, *Northwestern University, Evanston, Ills.*

NOTES AND NEWS.

MR. E. W. FISHER has been appointed curator of the herbarium of Indiana University.

A DICTIONARY of botanical terms by A. A. Crozier has recently been issued by Henry Holt & Co.

CORRECTION.—In Mr. A. F. Foerste's article in the August GAZETTE, on p. 244, Hamamelis Canadensis is mentioned twice. This was an oversight, since *H. Virginiana* was intended in both cases.

THE FOLLOWING PAPERS by Professor Pammel appear in the Proceedings of the Iowa Academy of Sciences, vol. 1, pt. 2: Woody plants of Western Wisconsin; and, Forest vegetation of the Upper Mississippi.

DR. H. L. RUSSELL, whose studies of marine bacteria and of the immunity of plants from bacterial diseases are among important recent contributions to bacteriology, has accepted a fellowship in biology in the University of Chicago.

MR. WALTER H. EVANS has been appointed by the Department of Agriculture, in the office of Experiment Stations, to have charge of the

compilation of the botanical work of the various Experiment Stations for the "Experiment Station Record."

THE ANATOMY of the stem of Wistaria has been studied by Carlton C. Curtiss, and the results published in the *Journal of the N. Y. Micr. Society* (viii, 79), and again issued as the twenty-eighth Contribution from the herbarium of Columbia College.

YEAST FREE from bacteria, molds, and other impurities, obtained by Hansen's method, has been in use in this country for three years past, according to the *American Brewers' Review*, and is likely to supersede the usual methods of preparation when required in large quantities.

A SYNOPTICAL LIST, with description, of the ferns and fern-allies of Jamaica, is being published by G. S. Jenma, Superintendent of the Botanical Gardens, Demerara, in the *Bulletin of the Botanical Department, Jamaica*. The tenth number appeared in the *Bulletin* for July The list includes many new species.

AN APPRECIATIVE notice of the life and works of Prof. Dr. Emil C. Hansen, of the Carlsberg Laboratory in Copenhagen, with portrait, appears in the *American Brewers' Review* for August 4 and 11. Dr. Hansen has greatly extended the knowledge of fermentation, and made many useful applications of his discoveries.

THE REPORT of the botanical department of the New Jersey Experiment Station for 1891 covers over a hundred pages of the fourth annual report of the Station recently issued. In this report Professor Halsted treats of a large number of fungous diseases of cultivated and wild plants and of the subject of weeds. The report is copiously illustrated.

GARDEN AND FOREST for September 21st, contains the following articles of general botanical interest: "Native shrubs of California," by Professor E. L. Greene (devoted to *Ceanothus*); "The Polemoniaceæ of the Lake Region," by E. J. Hill; and "The self-pollination of the grape," a paper read by Professor S. A. Beach at the Rochester meeting of the American Association.

PROFESSOR J. E. HUMPHREY has resigned his position as "vegetable physiologist" of the Massachusetts Agricultural Experiment Station, the resignation to take effect the first of January. After that time he will spend three or four months in Jamaica in the study of algæ and fungi. He hopes to secure some good developmental material, and to make cultures of Saprolegniaceæ, etc.

THE ENTIRE separate edition of "The Keys to Genera and Species of North American Mosses" reprinted by Prof. Barnes from vol. VIII of the "Transactions of the Wisconsin Academy of Sciences, Arts and Letters," has been disposed of. The pamphlet is therefore "out of print," and can only be obtained by purchasing the volume cited which may be had of the secretary, Dr. William H. Hobbs, Madison, Wis.

PROFESSOR L. H. PAMMEL, of Iowa Agricultural College, has distributed a sixty-page pamphlet containing the following papers: "A lecture on pollination of flowers," delivered at the State Horticultural Society, January, 1892; "Cross and self-fertilization in plants," a paper

read at the meeting of the Eastern Iowa Horticultural Society, December, 1891; and "The effects of cross-fertilization in plants," read at the meeting of the Northern Horticultural Society, December, 1891. The first paper is profusely illustrated.

THE SHRINKAGE of leaves during the process of drying for herbarium specimens has engaged the attention of Mr. E. E. Bogue, who gives measurements before and after drying in *Science* for September 16. From three to five leaves of Quercus coccinea, Arisæma triphyllum, Asimina triloba, Arctium Lappa, Asclepias Cornuti and six other common plants, were examined and found to shrink on an average of one to three-sixteenths of an inch, except the water plant, Nymphaea odorata, which shrank about an inch.

TWO INTERESTING new Uredineæ from South America are described by Dietel (*Hedwigia*, 1892, p. 159). One is a Ravenelia on Acacia, and the other is a Phragmidium on some leguminous plant. The latter merits special attention as it is the only member of the genus not parasitic on the Rosaceæ. It has been imperfectly known for a long time from material collected by Wright in Texas (Saccardo, Sylloge, vii, 749). It is also remarkable for the close agreement in the physical characters of the exospore with Uropyxis Amorphæ.

A LETTER from Prof. L. M. Underwood, delegate from the Botanical Club of the American Association to the International Botanical Congress at Genoa, announces that the attendance was large and representative. Articles I, II and III of the Berlin recommendations were adopted, except that the American suggestion prevails and 1753 was adopted as the uniform date for genera and species. Article IV and other matters were referred to a standing international committee, upon which the American representatives are N. L. Britton, J. M. Coulter and E. L. Greene.

THE FIRST and only circular of the World's Congress Auxiliary relating to botany, which was prepared last May, and should have been mailed from the Chicago office June 1, has been tardily distributed since the September number of the GAZETTE went to press. The chief design of the circular was to obtain the opinion of the botanists of the country upon the feasibility of holding a botanical congress in connection with the Columbian Exposition. The belated appearance of the circular has deprived it of all value, as the botanists at Rochester, acting as a representive body, decided unanimously that a congress under such auspices was not advisable, but that instead one should be held in connection with the meeting of the A. A. A. S. next year in Madison. This will doubtless be done, whatever replies are sent to the circular.

THE CONTRIBUTIONS from the Herbarium of Columbia College are multiplying rapidly. No. 27 is entitled "Note on a collection of Tertiary fossil plants from Potosi, Bolivia," by N. L. Britton. It contains descriptions of some eighteen species, illustrated by three plates. Eleven of the species are new! No. 28 is upon "The anatomy of the stem of *Wistaria Sinensis*," by Carlton C. Curtiss, illustrated by three plates. No. 29 is the sixth bearing the title "New or noteworthy North American phanerogams," by N. L. Britton. Among other notes a new

eastern *Cardamine* is separated from among other forms; the var. *mollis* of *Agrimonia Eupatoria* is raised to specific rank, as is also the var. *Americana* of *Fragaria vesca*; a new *Polemonium* of the North Atlantic states is described and figured; also a new *Phlox* from Montana and Dakota.

AT HIS OWN request Prof. C. R. Barnes has been relieved of revising Gray's "Field, Forest and Garden Botany." The prescribed limitations of space and the ever increasing number of species of cultivated and native plants which it seemed necessary to include proved irreconcilable. His feeling that he could not, under the conditions imposed, make a work satisfactory to himself, led Prof. Barnes to abandon the task. It has now been put into the hands of Prof. L. H. Bailey, whose extensive familiarity with the plants of our fields, forests and gardens will insure a careful and thorough revision. A tentative list of the species to be included, involving a considerable study of the nomenclature of cultivated plants, together with the first draft of the manuscript through Leguminosæ have been placed in Prof. Bailey's hands for such use as he may see fit to make of them.

TWO HUNDRED and forty dollars have been placed at the disposal of the American Microscopical society, to be given as prizes for the encouragement of microscopical research, and Profs. S. H. Gage, of Ithaca, N. Y., D. S. Kellicott, of Columbus, O., and W. H. Seaman, of Washington, D. C., were appointed a committee to prepare the conditions on which they should be granted. The competition will be open to members of the society and to those who make application for membership, before submitting their papers to the committee, which has prescribed the following conditions:

One prize of fifty dollars is offered for the best paper which shall give the results of an original investigation made with the microscope and relating to *plant* life, not less than 3,000 words in length. The methods by which the results were obtained must be given in full. A similar prize for an investigation relating to *animal* life.

Two prizes of twenty-five dollars each will be given for the second best papers on plant and animal life, respectively, on the above conditions.

The papers, drawings and specimens entered for the above prizes are to be submitted to the committee on or before July 1st, 1893, and the papers and drawings will be published in the Proceedings.

One prize of thirty dollars is offered for the best six photomicrographs on some subject in animal or vegetable histology, and another of the same amount for the best collection of six mounted slides illustrating some one biological subject.

There are also two prizes of fifteen dollars each for the second best collection of photomicrographs and slides respectively.

The object of these prizes is to stimulate and encourage original investigation in the biology of North America.

Additional information as to the conditions may be obtained of the committee on prizes.

BOTANICAL GAZETTE

NOVEMBER, 1892.

The International Congress at Genoa.

LUCIEN M. UNDERWOOD.

It may not be without interest to the botanists of America to know something of the Botanical Congress which assembled in Genoa September 4–11. In fact I feel it my duty to my colleagues, who conferred on me the honor of being their representative, to give at this earliest possible opportunity a somewhat detailed account of the meeting and its results. I will present here some of the general items of the journey, reserving for another place[1] an account of the discussion of the nomenclature problem.

A trip to Europe cannot properly be arranged for with two days notice. Yet my appointment as delegate from the Botanical Club of the A. A. A. S. was made on Monday, August 22d, and as the Congress opened Sunday, September 4th, my only chance of reaching Genoa at the opening session was to sail from New York Wednesday, August 24th, by the *Majestic* of the White Star Line. Returning by the first available steamer (on account of the present crowded condition of travel) I was even then over three weeks late with my lectures. It will thus be seen that the trip has been taken with some inconvenience to myself and sacrifice on the part of others.

At New York I met Dr. Vasey, who represented the Smithsonian Institution, and we proceeded together to Genoa, remained together most of the time, and returned together. We reached Genoa from Liverpool by the shortest route (*via* Mont Cenis) just after dark on Saturday, September 3d.

The opening reception at Genoa was held at the grand hall of the Municipio, and was, like all the receptions, decidedly informal. A few at the opening session of the Congress on the following day, mistaking the occasion, appeared in full

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[1] This paper, bearing even date with the present, I send to the *Bulletin of the Torrey Botanical Club.*

dress, but after maintaining a self-appointed conspicuity for a single session, reappeared in the afternoon clothed and in their right minds.

The moving spirit in the management of the Congress was Professor Penzig. In his capacity of general secretary he was the life of the entire Congress. Readily speaking four languages, of infinite patience, always cheerful, and even at times overflowing with good spirits, he conducted the affairs of the Congress in a manner that won him the admiration of every one in attendance. His tall gaunt form was everywhere, making strangers at home, answering the multitudinous detail of annoying questions, now attending to routine, now reading papers before the Congress, now carrying out the complicated business details of the excursions, unruffled, ubiquitous, urbane—the very soul of good nature, and a prince in management.

While the official language of the Congress was Italian, none of the presiding officers used it, and it would be difficult to say whether Italian, French or German predominated; in the heat of discussion the polyglot approximated the Babel of tongues. The soft, rhythmic cadences of the expressive Italian were followed by the earnest but often harsh tones of the deep, soul-stirring German; the suave nasals of the polished French succeeded the blunt but copious and effective English. Never were we more happily disappointed in the apparent strength of a spoken language, as compared with its seemingly weak terminations in print, than we were in listening to the Italian. Never were we so impressed with the necessity of a common language for scientific intercourse; never more convinced that English will ultimately be that chosen language.

At the opening of the scientific sessions which were held in the grand hall of the University[2] Thomas Hanbury was made the honorary president of the sessions. There were thirty-six vice presidents of whom Ascherson, Burnat, Bonnet, Borodin, Chodat, Durand, Haussknecht, Kny, Magnus, Magnin, Moore, Prantl, Pfitzer, Radlkofer, Strasburger, Underwood, Vasey, Vilmorin, Marshall-Ward and Wright were present. The ballot among the vice presidents for the first

[2]Founded as a Jesuit College, 1623; university organization established in 1812.

presiding officer led to a very close count between Penzig and Strasburger, the latter attaining the position by a majority of one. The further sessions were presided over in order by Vasey, Vilmorin, Borodin, Marshall-Ward, Burnat, and Durand, each using his native speech except Strasburger and Borodin who used French.

The number of delegates in actual attendance is a difficult question to determine. A list of members of the Congress was published and early distributed, but this included several who had expected to be present but were unfortunately detained. Of the 196 names published in the list we know of at least 28 who were not present; among these were Cohn, von Thümen, Brefeld, N. L. Britton, Bailey-Balfour, Malinvaud and Thistleton-Dyer.

The members of the list (of whom we personally met 62) were divided among the various nationalities as follows: Italy 108, Germany 25, France 13, Great Britain 12 (of whom only six were present), Austro-Hungary 9, United States 6 (of whom three were present), Switzerland 4, Belgium 3, Scandinavia 3 (of whom only one was present), Russia, Spain and Turkey each one. Ten others were distributed from Mexico and Cuba to Mauritius and New Zealand, but none of these were present. The actual attendance, limited mainly to members of the Congress, probably ranged from 100 to 150. Among the better known Italian botanists present were Penzig, Saccardo, Massalongo, De Toni, Arcangeli, Berlese, Caruel, Cavara, Delpino, St. Sommier, Martelli, and others. Among the Germans were Ascherson, Kny, Klein, Magnus, Prantl, Pfitzer, Radlkofer, Strasburger, and Haussknecht. Vilmorin, Burnat and Bonnet represented France; Chodat, Switzerland; Durand, Belgium; and Borodin, Russia. Marshall-Ward was the leader of the British delegation which was equally divided between the English and Irish botanists. In addition to Dr. Vasey and myself, America was represented by Prof. Henrietta Hooker of Mt. Holyoke College, the only educational institution that sent a delegate to the Congress. Mt. Holyoke was further represented by two of the graduates from its botanical laboratory, Miss Catharine Barbour, of San Sebastian, Spain, and Miss Arma Smith, of Constantinople, who are pioneer botanical missionaries from the new world to the botanically less-known regions of the old, and

are carrying American methods to the slower and more conservative nations of Europe.

Each delegate was presented with a card of membership and an elaborate button-hole badge with the inscription "Congresso Internazionale Botanico Genova 1892" in black letters on a gilt border, and with the arms of Genoa, including the red cross of Savoy, in gilt on a white field.[3] We were also given a guide to Genoa which was a special edition of a well known German guide[4] bound, with coupons and stubs for our various excursions and entertainments, in a special board cover labeled in true German style "Congresso Botanico Jnternazionale."

The session of Monday forenoon was given up largely to the formalities of opening the Congress, the addresses of welcome by Arcangeli, President of the *Societa Botanica Italiana*, and others, the election of presiding officer for the afternoon session, the greeting from Strasburger, presiding officer elect, and general notices for the sessions and excursions. On Monday afternoon the reading of papers was taken up, commencing with one by Strasburger "Ueber Schwärmsporen, Gameten, Spermatozoiden und die Befruchtung," followed by others by Saccardo, Massalongo, and Arcangeli. Opportunity for discussion was given after each paper and some elicited considerable spirit and enthusiasm. During the congress forty-three papers were read by thirty-two persons. Of these papers twenty-five were by Italians, seven by French, six by Germans, two by Swiss, two by Russian and one by Belgian botanists, covering a wide range as will be seen from a few selected topics: "Sopra alcuni entomocecidii Italiani." "Sur l'électricité statique et son action sur la vegetation." "Zur physiologischen Bedeutung des Anthocyans." "Sur les dépots diffus d'oxalate de chaux dans les feuilles." "Zum Schütz des Edelweiss." "Note teratologiche sui fiori di alcune Orchidee indigene." "Ricerche sul nucleo e le cellule sessuali presso le piante crittogame.

On Tuesday morning the Hanbury Botanical Institute was formally dedicated. This was a gift from Mr. Thomas Hanbury of Mortola to the University of Genoa and completes a

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[3]Our own Botanical Section might well take an idea from this and provide a permanent badge that could be worn at the A. A. A. S. meetings each year in place of the curling ribbons.

[4]Bruckmann, Villes et paysages du monde entier. No. 18, Munich.

very superior equipment for purposes of botanical instruction and research. Genoa "la superba," forms a crescent about the harbor and extends up the steep slopes of the foot hills that come down almost to the sea. From the upper story of the University one goes across a passage-way to the lower terraces of an extensive botanic garden where a diverse collection of plants has long been under cultivation. Passing to the upper terraces of the garden we come finally to a broad plateau, whence one can look over the blue Mediterranean and along the olive-crowned slopes of the Ligurian coast, hazy in the mellow Italian sunshine. On this plateau is the Hanbury Institute, now presided over by Professor Penzig, the able successor of Guiseppe De Notaris. Mr. Hanbury, a wealthy Englishman who spends his winters at his extensive Italian garden, has liberally endowed this institute and equipped its laboratories for anatomical and physiological work and has greatly extended its herbarium and enlarged its museum, making it in every respect a model for botanical instruction. The exercises were simple but impressive and ended with the unveiling of an admirable and life-like bronze of Mr. Hanbury. Following these exercises the Congress was twice grouped in the garden and photographed. The afternoon session of Tuesday was presided over by Dr. Vasey, who opened with a graceful speech in which, as the representative from the Smithsonian Institution, he touchingly alluded to the grave of Smithson in the English cemetery just outside the city of Genoa, and briefly set forth the present state of botanical research and development in America. Then followed Professor Ascherson's paper, "Sur la reforme de la nomenclature botanique," in which he presented essentially the substance of his recently published paper.[5] After this we presented the Rochester platform and the remainder of the session was taken up with the discussion of the nomenclature problem, ending with the approval of I, II and III of the Berlin propositions with the substitution in the first of the date 1753 for both genera and species, and the appointment of a standing committee to whom all other nomenclatural problems were to be referred.[6]

[5] Berichte der deutschen botanischen Gesellschaft, x, 327—359.

[6] As some who read this may not see the full account in the *Bulletin of the Torrey Botanical Club*, it may be well to add here that the American members of this committee are Dr. Britton, of New York, Dr. J. M. Coulter, of Indiana, and Prof. Greene, of California.

Wednesday was given up to a most enjoyable excursion, first by sea to Portofino, then by carriages to Santa Margherita, where a reception with wine and lunch was furnished in the Municipio, after which we were taken to the Gran Hotel on the hill overlooking the sea, where an elaborate collation was served, after which toasts were drank and responded to in truly continental style. The carriages then took us to Rapallo, where we were again wined, and mutual toasts were indulged in at the Municipio by the city officials and the visiting guests. We then proceeded to Recco, where we were obliged to decline a third entertainment for lack of time. From Recco we took the train to Genoa. The country at this time seemed dry, and botanically uninteresting, in landscape, haze and vegetation reminding one of central California during the dry season. A few straggling spermaphytes were in flower by the wayside, a *Selaginella* grew in profusion in a damp ditch, two or three ferns, mostly shriveled by the drought, appeared on the walls which bordered the streets; among them we recognized *Asplenium trichomanes*, *Ceterach officinarum* and *Adiantum capillus-veneris*, the latter more common at the watering places, where a few hepatics also maintained a doubtful existence. On shaded walls were a few mosses, and under the chestnut trees two or three agarics and boleti were growing. Orchards and vineyards, olive groves and chestnut trees made up the bulk of the cultivated vegetation, though oaks, poplars and chestnuts served for shade trees, and some lemons were in cultivation in gardens. The hills were bare of native forests, the harvest was mainly gathered and the soft haze of the golden sunshine betokened the beginning of the season of rest.

On Thursday morning the reading of papers was resumed. While giving the daily notices Prof. Penzig announced the gift to the Institute of an elaborate two-volume folio of illustrations of the plants of the region drawn and colored by hand by a Capuchin monk, who was present *in propria persona* and rose while the notice was being given. As King Humbert and Queen Margherita made a visit to Genoa and the Columbian exposition during the week of the Congress, Thursday afternoon, on which the king arrived by sea, was given up to the royal festivities. The vice-presidents were

further honored by invitations to the royal ball, which was held on Friday night.

As the Palazzo Reale was almost opposite the university, the sessions of Friday were somewhat interrupted by the clamors of the people in the narrow street for the recognition of the king. The day was almost wholly given up to the completion of the papers of the printed program, several of which were read only in abstract; some routine work of committees was attended to, and Prof. Penzig presented each visiting delegate with a representative and carefully selected fascicle of the flora of upper Italy, neatly prepared and marked in silvered letters:

Congresso Internazionale Botanico,

Genova,

1892.

O. PENZIG.

Selectæ Stirpes Liguriæ.

On Saturday an excursion was taken to Ventimiglia, a city of the Mediterranean coast, not far from Nice, and thence to Mortola, where Mr. Hanbury owns one of the most elaborate private gardens of the whole Mediterranean region. This over, the Congress was informally adjourned.

Were we called upon to suggest any changes of program or method for a gathering of botanists even more successful than this, we would say (1) reduce the number of papers read, (2) introduce a few topics for discussion that would command universal attention, (3) increase the facilities for personal and social intercourse among the members. The grand object of such a meeting is to facilitate the personal acquaintance of members and the discussion of questions of general interest, rather than stiff formality and the presentation and discussion of local questions. Every effort to secure these two ends should be most carefully studied.

De Pauw University, Greencastle, Ind.

Some new North American plants. I.

JOHN M. COULTER AND E. M. FISHER.

Heuchera Hapemani, n. sp. Stem short and slender (10 to 22 cm. high), densely glandular above, with rather few leaves, from a slender running rootstock: leaves (both radical and cauline) round-reniform (3 to 3.5 cm. broad), thin, glabrous, deeply 7 to 9 lobed (lobes dentate, with a linear gland in the sinuses), on slender grooved petioles: panicle loose and racemose; bracts and bractlets small and foliaceous: flowers on pedicels much shorter than the calyx, which is turbinate, 4 to 5 mm. long, the thin acute lobes one-third as long as the ovary: petals white (often purplish), entire, short clawed, 3 mm. long: stamens included, with very small anthers.—Big Horn Mountains, Wyoming, *Dr. H. Hapeman*, who says "the plants grew at the base of a cliff, near the water, in dark places. They follow the cracks in the rock by a slender running rootstocks." The species belongs to the group containing *H. Hallii*, but its leafy stem, deeply lobed and dentate (neither bristly nor ciliate) reniform leaves, narrower and pointed calyx-lobes, much longer and ovate short clawed petals, and its very small stamens, are characters which distinctly separate it.

BOERHAAVIA ANISOPHYLLA Gray, var. **paniculata** n. var. —As compared with the type, this plant has larger and very diffuse panicles, smaller flowers mostly solitary at the extremity of the branchlets, calyx pubescent along the ribs, and purplish pubescent fruit (4 mm. long) rugose between the ribs.—Chenate Mountains (*Nealley* 405).

Abronia Suksdorfii, n. sp.—More or less viscid-pubescent: stem erect, 4 dm. high from a perennial base: leaves obtuse, elliptical-ovate or oblong-oval, slightly rounded at base: peduncles 8 to 15 cm. long (twice longer than the leaves): bracts 5, white-scarious, linear-lanceolate (8 mm. long), acute, subtending 8 to 16 slender flowers: perianth greenish-white, the lobes obcordate: fruit indurated, broader than long, with 5 broad wings which are neither reticulated nor crested.—Sandy grounds near Columbus, Klickitat Co., Washington, June 11, 1886, *W. N. Suksdorf*. Distributed as *A. mellifera* Dougl. The species cannot be grouped with *A. mellifera*, as the wings are double and very coriaceous. The relationship

is nearest to *A. fragrans*, but the narrow involucral bracts and the broader and more coriaceous wing, with no reticulations, seem well to separate it.

Abronia Carletoni; n. sp.—Stems procumbent, slender, whitish, minutely glandular, 2.5 to 4 dm. long: leaves very thick, linear-oblong or oblong-ovate, with cuneate base and revolute margins: peduncles very slender, as long as the leaves: involucral bracts 5, rose-color, oblong-lanceolate, attenuate or cuspidate, 6 mm. long: flowers numerous: perianth rose-color, with obcordate lobes: fruit longer than broad, scarcely coriaceous, with the 5 wings coarsely reticulated and terminating above in disks.—E. Colorado, *Prof. M. A. Carleton* 459, 1891. Most closely related to *A. turbinata* Torr., having the coriaceous double wing of the section, but differing from that species in having slender white glabrous (but minutely glandular) stems, more numerous flowers, broader rose-colored attenuate or cuspidate bracts, and the perianth and its lobes not so deeply cut.

Gomphrena Pringlei, n. sp.—Low, procumbent, strigose-pubescent, from a long filiform root: stems many, rose-color, di- or trichotomously branched, 5 to 7 cm. long: leaves half-clasping, oblong-lanceolate, mucronulate, 1-nerved, 1 to 1.5 cm. long: heads many, globose, dense, white (slightly rose-tinted), 5 to 8 mm. long, subtended by 3 or 4 leaves; the denticulate long-acuminate bracts equalling the keeled and broadly crested (dentate) acute bractlets: sepals woolly, cleft to near the base (the segments linear, acute), shorter than the bractlet: stamen-tube united to the top, with linear-oblong exserted anthers: stigmas 2, recurved, together with ovary and style equalling the stamen-tube.—*Pringle* 3152, of the state of Mexico, distributed as *G. decumbens* Jacq. Very different from any described Gomphrena. The flowers and bractlets are somewhat similar to those of *G. tuberifera*, while the very short and procumbent branches seem to relate it to *G. decumbens*.

Gomphrena Nealleyi, n. sp.—Ascending, 14 to 20 cm. high, loosely long-villous, from a fusiform root: leaves spatulate, mucronulate, glabrate above, half-clasping, 3 to 3.5 cm. long; the upper ovate and much smaller: peduncle terminal, about 9 to 11 cm. long: heads rose-tinted, sessile, dense, oblong-obovate, 2 cm. or more long, subtended by two larger leaves:

flowers 5 mm. long: bracts ovate, acute, half as long as the keeled and slightly crested acute bractlets: sepals linear-lanceolate, slightly cleft, densely woolly below, little shorter than the bractlets: stamen-tube united to the top, with linear-oblong exserted anthers: stigmas, 2, minute, spreading.—Corpus Christi, Texas. *Nealley* 420, referred to *G. nitida* Roth. in Contr. Nat. Herb. I. 48. In general appearance this species simulates *G. decumbens*, but the subsessile stigmas place it in an entirely different section.

Frœlichia Texana, n. sp.— Erect, silky-villous, 5 dm. or more high, sparingly branched from a perennial base: leaves usually obtuse and mucronate, farinose, whitish and densely silky below; the radical spatulate, 8 to 9 cm long, tapering to a slender petiole; the cauline short-petioled or subsessile, oblong or elliptical-ovate, 2.5 to 3.5 cm. long: peduncles terminal, the spikes 3cm. long, lengthening and becoming scattered in age: flowers 5mm. long, with thin bracts and bractlets, the latter very broad and deeply concave: fruiting calyx fuscous, cordate, flat on one side, the wings pale, broad, crenate.—Pena, Western Texas. *Nealley* 521, referred to *F. Floridana* Moq. in Contr. Nat. Herb. I.48. The species most nearly resembles *F. Floridana*, but differs in its elliptical-ovate leaves, very broad and deeply curved bractlets, and cordate fruiting calyx (flat on one side) with pale crenate wings.

Eriogonum Texanum, n. sp.—A stout subtomentose perennial, about 6 dm. high, simple, woody below, naked above: leaves very coriaceous, linear-lanceolate, 7 to 10 cm. long, tapering below to a short clasping petiole, densely tomentose beneath, silky-villous above: inflorescence twice or thrice di- or trichotomous, with divaricate branches: involucre solitary, sessile, coriaceous, 5 to 7 mm. long, with five short and round teeth: flowers yellowish, on long pedicels, densely silky-villous, 7 to 8mm. long: perianth segments similar, oblong-lanceolate, thickish, with rugose margins.—W. Texas, *Nealley*, 1890. This species belongs to § OREGONIUM, and seems to be unlike all others in the very coriaceous texture of the leaves and inflorescence, the former with a very prominent midrib. The very thick involucre is strongly nerved (as seen within), its teeth tipped with a short mucro, and the central ones are short pedunculate.

Eriogonum Pringlei, n. sp.—Woody, 3 dm. high, densely white tomentose, leafy throughout, with flaky bark, and many slender intricate branches above, each terminated by a loose paniculate spike (4 to 6 cm. long), leaves linear, acute, very small (1 cm. long,) narrower toward the base, strongly revolute, often with smaller ones fascicled at the base of the branchlets: bracts very small, triangular to setaceous: involucres sessile, small (2 cm. long), 6 to 9, regularly distributed, each containing 4 or 5 minute whitish or slightly rose-colored flowers (2 mm. long).—Rocky hills near Maricopa, Arizona, *Pringle*, in 1882, and distributed as "*E. Wrightii* Torr., var., or a new species." It is nearest to *E. Wrightii* Torr., but its flaky bark, many intricate branchlets, short linear revolute leaves, numerous spikelets with smaller and regularly arranged involucres and flowers, narrower and lighter colored sepals, and smooth achenes make it a very distinct species.

Euphorbia Nealleyi, n. sp.--Densely puberulent throughout; stems slender, erect or ascending (2 to 3 dm. high), branched or simple at the woody base, with few alternate branches above: leaves opposite, linear, (2 to 3 cm. long, 1 to 1.5 mm. wide), entire, short-petioled, thickish, acute, cuspidate; glandular stipules minute: involucres solitary, axillary and terminal, pedunculate, turbinate; glands 4, transversely oblong, with large and white irregularly dentate truncate appendages: style short: pod rather depressed, about 3 mm. broad: seed ovate-triangular, deeply and irregularly transverse sulcate.—W. Texas (*Nealley*, 1890). This species belongs to § ALECTEROCTONUM except the leaves are simply opposite and not ternate or verticillate. Its general appearance is that of *E. biformis* Watson, but its stems are alternately branched and its seeds are strongly sulcate. It really seems to be somewhat intermediate between the sections Alecteroctonum and Zygophyllidium.

Ricinella Vaseyi (Coulter.) *Euphorbia Vaseyi* Coulter, Contr. U. S. Nat. Herb. I, 48. Since the publication of this species additional material and information have come to hand, which make it evident that it must be referred to *Ricinella* (*Adelia.*) In addition to the characters given in the contribution referred to the following may be added: The plant is a diœcious shrub, 15 to 18 dm. high, with several

straight branches from the root. The staminate flowers have five sepals and ten stamens, and fall off at once when touched. The species is most nearly related to the West Indian *Ricinella pedunculosa* Muell. (*Adelia Ricinella*), but its simple long stems (branched at base,) small coriaceous to three nerved narrowly obovate non-punctate leaves (not shining above), single and short (1.5 cm.) fruiting pedicel, and much larger angulate seed with prominent hilum, make it a very distinct species. From Brazos Santiago and Booneville, Texas (*Nealley*).

Sisyrinchium Thurowi, n. sp. Low (4 to 7 cm. high), cespitose and procumbent: stems rather broadly winged, with a flower-bearing branch at each node: leaves short, scarcely 2 mm. broad: corolla 4 to 5 mm. long: outer bracts a little longer than the very slender pedicels: flowers small, yellow, 2 to 4 in each umbel: pods oblong or pear shaped (4 to 5 mm. long), prominently transversely wrinkled between the seeds, which are 10 to 14 in each cell, depressed-globose, very small (scarcely 0.5 mm. broad), black and deeply punctate. --Hockley, Texas, *Thurow*. Nearest *S. Schaffneri* Wats., but smaller, densely cespitose and procumbent, not at all scapose (the stems bearing leaves and flowering branches), with smaller leaves, smaller, firmer and more deeply wrinkled pods, and very minute black punctate seeds.

Fritillaria linearis, n. sp. Bulb scales few and thick: stem 20 to 25 cm. high: leaves (10 or more) narrowly linear-lanceolate, scattered, more or less whorled below: flowers 2, blotched with brownish purple within, 2 cm. long, the segments ovate-lanceolate, slightly spreading at the tips, much longer than the style, which is deeply parted and much longer than the stamens.—Black Hills of Dakota. In some way the name of the collector has been lost. The species is nearest *F. biflora*, but is much lower, leafy throughout with linear leaves, ovate-lanceolate lighter colored perianth segments, and much smaller stamens on filaments much shorter than the deeply parted styles.

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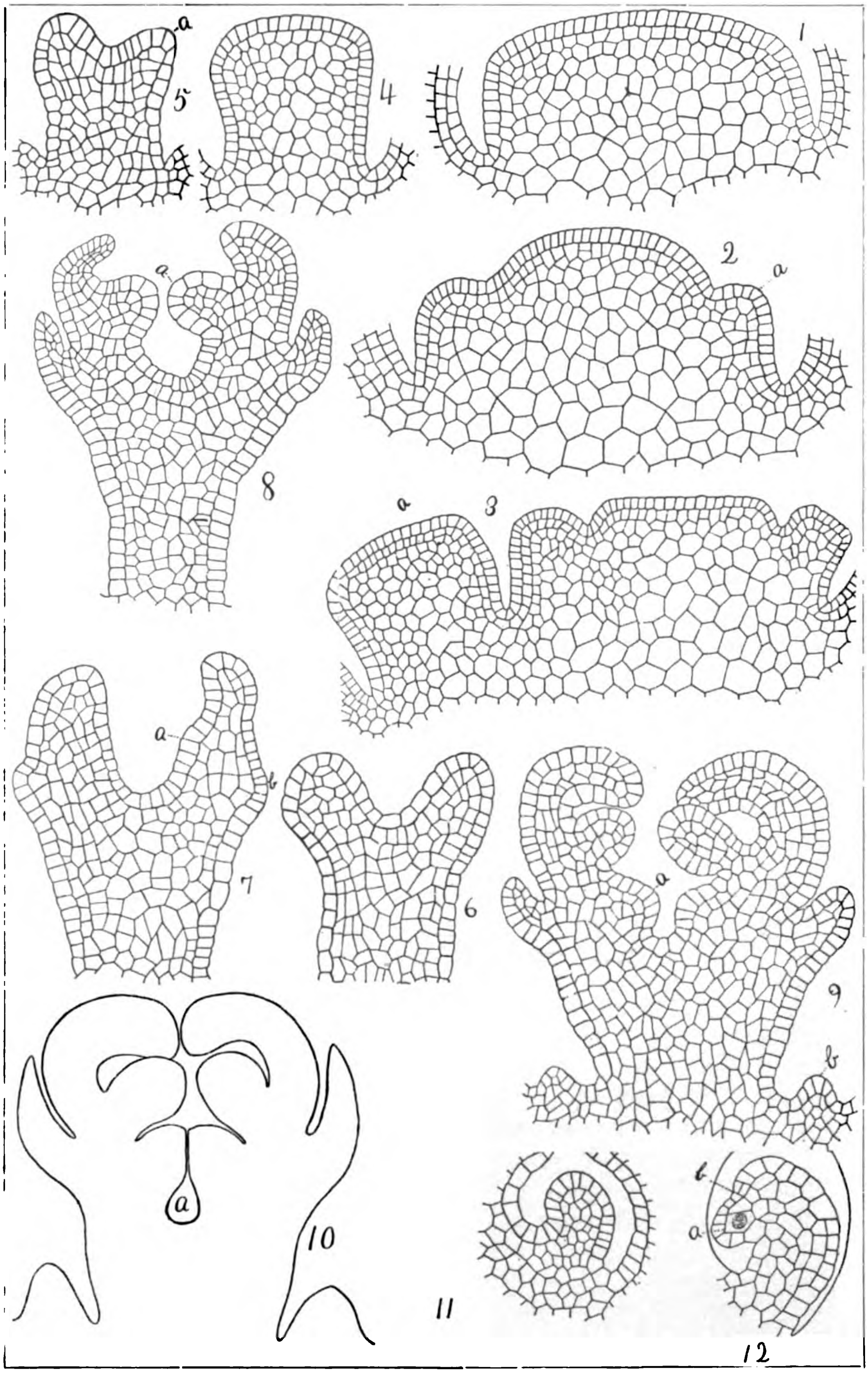

MARTIN on ASTER and SOLIDAGO.

Development of the flower and embryo-sac in Aster and Solidago.

G. W. MARTIN.

(WITH PLATES XIX AND XX.)

Before entering directly upon the subject it may be well to recount the primitive conditions of the leaf-shoot and its growing point as found in Compositæ. The point of growth of the shoot-axis becomes very much retarded, and as a result, the growing-point is transformed into a broad, somewhat elevated disc, on which are to appear flowering capitula with centripetal inflorescence (fig. 1). The first structure indicating an individual, embryonic flower on the receptacle is a hemispherical outgrowth almost perfect in outline, and becoming obconical as growth takes place (figs. 2a and 3a).[1] This embryonic tissue, standing on a lateral axis, constitutes the foundation from which arises a differentiation of tissue into special organs (fig. 4). Thus far the path of embryonic development remains the same for all organs, even those of the most various kinds. From this condition of things on a new departure is made; the apex of the broad flower-axis ceases to grow, while the peripheral portion continues to develop; and here we have the first hint of the initial growth of true floral organs (fig. 5). A tubular ring is thus formed, and on its peripheral wall small papillæ arise, giving the structure a cup-shaped appearance with a shallow depression and scalloped margin (fig. 5a). This so-called cup elongates; its sinus grows deeper, and the five corolla lobes become sharply defined and are known at once by their shape (fig. 6). Simultaneously with the development of the floral organs in the rising ring, in which there is a complete fusion of all flower parts till liberated a deep, central depression is forming, when ultimately the ovule-bearing portion is placed beneath the rest of the flower-parts (figs. 6–10). Thus we have an epigynous flower with an inferior ovary.[2] However, there are some who would substitute the word hypogynous for epigynous, basing their argument on the theory that all the floral organs in their initial state are coalesced in the annular

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[1] Just here may be stated that this rudimentary, sessile floret is the firstindication of plant subdivision.

[2] Gray's Structural Botany, p. 183.

wall; that the appearance of each is due to the liberation of their uppermost parts; that each whorl may appear either in acropetal or certain whorls seemingly in basipetal order.[8] The real origin and behavior of the floral organs in their younger stages of development as correlated with the inferior ovary has attracted but little attention, and therefore, no definite statement can be made as to the true relationship existing between the floral organs in their embryonic condition.

Turning now to the order of development of flower parts, the first foliar structure that appears is a petal. At first they appear as small papillæ on the annular wall (fig. 5a). In their further development the tissue thickens and the epidermal cells with their rather heavy cell walls become quite large; in later growth the tissue becomes more uniform, and the tips of the five marginal teeth of the corolla-tube turn inward, thus furnishing a splendid protection to the andrœcium and gynæcium (figs. 7–10). The petals forming the flower tube are not simply contiguous but united, and as the tube elongates it assumes the form of a funnel whose upper margin has five spreading teeth. The tubular corolla is not composed of parts originally separate and subsequently united by their lateral margins; for the parts set free are the marginal teeth arising from a common, basal tissue; and this tissue develops and elongates *pari passu* with the growth of the nascent organs within.

Almost immediately following the visible corolla, appearing on its inner basal margin, are five minute elevations, the rudimentary stamens (fig. 7a). These develop with remarkable rapidity, and their primitive oval form is soon exchanged for one that is oblong (fig. 8a). The histological structure of the stamen in its early growth is a mass of uniform parenchyma. Presently a new condition arises; a differentiation of tissue into anther-lobes and a connective takes place. The fibro-vascular bundle, which is a continuation of that of the flower-axis, though very much reduced, differentiates in the upper part of the stamen and forms the so-called connective. At the same time there is a modification of tissue which develops into anther-lobes; these are connected and yet separated by the connective. In the early process of growth there appear two longitudinal ridges

[8]Coulter on the Dandelion, Amer. Naturalist, xvii, No. 12, p. 1212.

on each half-anther-lobe; these answer to the future pollen-sacs, and give rise to the archesporium cells, which, usually having but one row of cells in each pollen-sac, again give rise to the squarish mother-cells; in turn the latter yield four pollen grains each. The developmental path pursued by all pollen grains is so common that it needs no special description. To give a more complete account of stamineal tissue, mention also should be made of the anther-tube. At first the filament develops slowly and the stamens are distinct from one another, but just preceding the unfolding of the flower-bud the filament gains length at a very rapid rate by the elongation of its cells; finally, the lateral margins of the anthers become coalescent, thus forming a tube, which, when the flower is fully developed, projects beyond the tubular-corolla. The anthers do not simply cohere but unite, for cross-sections show the blending of epidermal tissue; this makes the union complete. Simultaneously with the origin and development of the stamen another structure comes into view, the calyx (fig. 7b). When first observed there is a bulging-out of the epidermal layer in the region of the seeming insertion of the other floral parts. The tube of this outgrowth is not distinguishable from the ovarian wall, but its limb is visible as a tuft of hairs. Primitively, it consists of a short delicate bunch of hairs, arranged in a circle at the upper extremity of the young ovary. Later, the hairs by rapid growth develop into long appendages, made up of several rows of narrow but extremely elongated cells, the lower ends of which splice into the upper ends of the cells below at the point where the upper end of the cell below turns away from the main trunk, and rapidly tapers into an acuminate tip; hence, the hair has the appearance of a barbed spear. By its late appearance in development, and its epidermal structure, some do not regard pappus as a calyx, while on the other hand others so consider it, though very much reduced in form and structure, caused by the pressure of surrounding parts.

A little previous to the formation of the pistil another structure may be seen to arise from the receptacle between the individual florets (fig. 9b). These foliar bodies, or bracteoles, very much resemble the scale-like leaves of poorly developed vegetative branches. They project quite far between

the individual flowers. Their epidermal tissue consists of very thick walled, elongated cells surrounding several layers of smaller parenchyma cells.

The next and last set of floral organs to appear is the pistil. About the time when the stamens begin to assume an oval outline and form a constriction near their bases, thereby separating the stamineal tissue into anther and filament, there is detected on the inner border of the primitive ring, in the region of stamineal insertion, an inward growth of cells (fig. 9a). This cell tissue gradually develops inward around a common axis till all sides meet, and at the same time elongates in the direction of the flower axis, thus forming the style above, and completely overarching the once oval cavity below, changing it into a flask-shaped cavity which is the true ovarian cell (fig. 10a). Just at this stage of development it may be mentioned that from now on, the flower parts develop with remarkable rapidity, and finally the flower axis is very much elongated, the gynœcium forming the terminal structure of the flower. The growth of the pistil is somewhat analogous to that of the stamen. As before stated, stamineal growth is partially retarded up to a certain point, from whence it makes rapid strides by the elongation of the cells of the filament; and for a time the stamen crowns the summit of the flower. So there is a similar phase of growth which characterizes the style; there is a slight cessation of its growth until the anthers begin to shed their pollen, when the style by rapid development pushes its way up through the syngenesious stamens. The lengthening of the style is due to the growth and elongation of the carpellary cells above the ovary. In this case is found a good example of protandry, which suggests cross-pollination. After the opening of the flower, the style lengthens and the pollen is pushed out of the anther-tube by the brush-like upper portion of the style as the anthers dehisce. The lines of the stigmatic receptive surfaces remain intact till that portion of the two-branched style is shoved above the anther-tube, whence the two branches separate, curving far back, and expose the stigmatic papillæ on their inner faces; thus the style is made the instrument for disseminating the pollen which it cannot use for itself; as a result, cross-pollination, with almost absolute certainty, is insured. To speak further of the two-branched style: Two kinds of

hairs are detected; these comprise stigmatic papillæ and brush hairs. The former are usually short, being either acutely or obtusely tipped, and are confined to the inner faces of the style-branches. The latter are cylindrical, epidermal outgrowths, having various arrangements both on the inner and outer faces of the style-branches. In the *Aster* the style-branches are flattened, and linear from their bases to the ends of the two lines of papillæ which line each stigmatic surface. Above the termination of the stigmatic lines are seen brush hairs which cover both faces of the style branches. In the *Solidago* the style-branches very much resemble in outline those of the *Aster*. Two stigmatic lines are observed which extend from the base of the branch to a point about one-half the distance to its tip. The brush hairs usually cover the whole outer surface of the branch, and the edges and the tip of the inner face above the termination of the stigmatic lines.

It yet remains to speak of the tissue and its modifications that make up the structure of the style. It consists, chiefly, of ordinary parenchyma, the central portion of which is modified, while the upper stigmatic portion is a differentiation of the epidermis into a soft mucilaginous tissue, thus forming a loose conducting mass for the penetration of the pollen-tube.[4] In the center of the conducting tissue is also seen a very narrow tubular opening, indicating that it is a continuation of the ovarian cavity. This seems to be constant throughout the species examined. Before concluding, however, the description of the different floral organs, let the following order of succession as observed in their sequence of development be noted, viz., corolla, calyx, androecium and gynoecium; although this order of parts does not correspond to Gœbel's generalizations on Compositæ.[5] There may be evidences showing a disturbance in the acropetal order of development of whorls, but of necessity the calyx is developed first, and its late appearance without doubt is due to the late liberation of its upper portion.

Simultaneously with the development of the ovule as far advanced as fig. 12, appear small, fleshy glands above the ovary at the base of the style these form a disk and are supposed to represent an inner row of imperfectly formed stamens.

[TO BE CONCLUDED]

[4] From all observations made I could not satisfactorily make out the descent of a pollen-tube.

[5] Gœbel's Outlines of Classification and Special Morphology, p. 422.

EXPLANATION OF PLATES XIX AND XX.

(All figures on Plate XIX are magnified 450 diameters; all on Plate XX 600 diameters).

Figs. 1, 2 and 3, receptacle of the flower axis, with individual florets appearing in Figs. 2 and 3*a*. Fig. 4, a single floret before the appearance of flower parts. Fig. 5*a*, the first floral whorl, the corolla. Fig. 6, further development of corolla. Fig. 7, the corolla, the appearance of the andrœcium *a* and the calyx *b*. Fig. 8, a later stage of fig. 7. Fig. 9*a*, the formation of the ovary; *b*, the bracteole. Fig. 10, a further development of fig. 9, showing the flask-shaped ovary *a*. Fig. 11, the formation of the ovule with all other parts eliminated. Fig. 12*a*, the nucellus of the ovule; *b*, appearance of the integument. Fig. 13, later development of fig. 12; *a*, the nucellus; *b*, the embryo-sac. Fig. 14, a further development of fig. 13. Fig. 15, the mother-cell divided once. Fig. 16, the cells divided again. Fig. 17*a*, the true mother-cell of the embryo-sac, the upper three cells becoming disorganized. Fig. 18, disappearance of the upper cells, the mother cell occupying a central position, the nucellus breaking up and showing signs of disappearance. Fig. 19, a further development of Fig. 18; the nuçellus almost gone and the appearance of vacuoles. From fig. 20 to fig. 23, inclusive, are shown the division of the mother-cell and its further divisions, culminating in the formation of the egg-apparatus, the antipodal cells and the endosperm nucleus; the vacuoles and the expansion of the embryo-sac.

A study of some anatomical characters of North-American Gramineæ. IV.

THEO. HOLM.

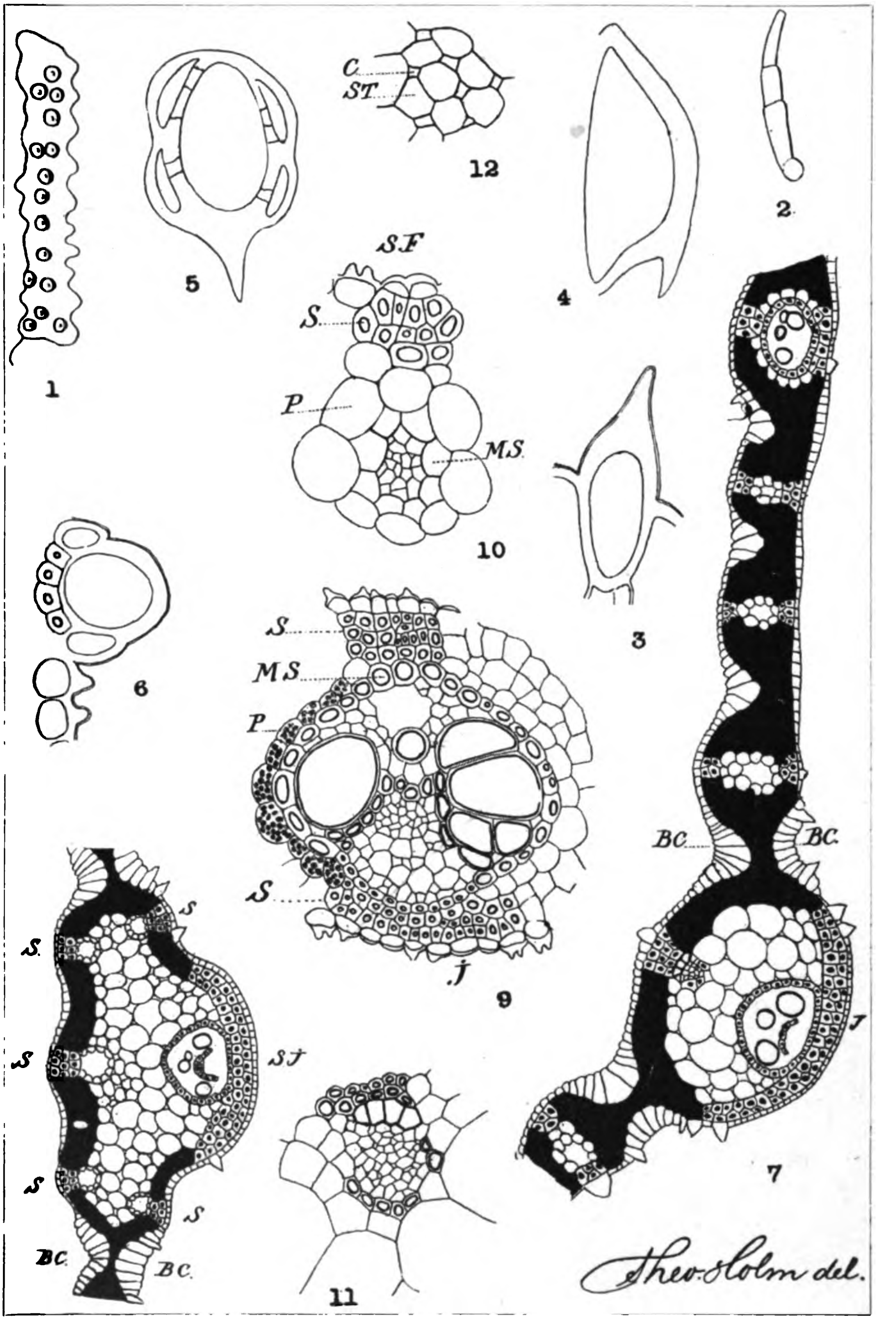
The genus Leersia.

(WITH PLATE XXI.)

In previously published papers[1] the anatomical characters of Uniola, Distichlis and Pleuropogon have been discussed, and it is the purpose of this, and a following paper, to show how the species of Leersia may be distinguished anatomically.

It would, of course, have been more proper to proceed from Uniola to the genera allied to it. This was done when the comparison was drawn between Uniola, Distichlis, and Pleuropogon; but the lack of sufficient material has necessitated a change in the order of treatment. Some groups, at least, of closely related genera may be considered at once, so as to give a broader view of their anatomical divergencies.

[1]Botanical Gazette, June, August and October, 1891.



HOLM on LEERSIA.

Five species of Leersia are enumerated from this country, namely: *L. oryzoides* Swtz., *L. Virginica* Willd., *L. lenticularis* Michx., *L. monandra* Swtz. and *L. hexandra* Swtz.

LEERSIA ORYZOIDES Swtz. A series of anatomical sections has been figured on plate XX, and the rule has been followed strictly, as before, of taking the sections from the middle part of the blade of completely developed leaves. It must be noted, however, that such leaves only have been used for examination as are situated at the base of the culms or those belonging to the shoots of innovation.

The epidermis of the inferior face is very rough from several kinds of expansions, and represents two forms of cells: the proper epidermis cells and the bulliform cells. The first of these are rectangular, with thin undulate radial walls and strongly thickened exterior ones. Seen in transverse section (plate XX, fig. 9) they show a rather narrow lumen. These cells cover the entire face, excepting the two lines on the sides of the carene, where the bulliform cells are to be observed (figs. 7 and 8, at *BC.*). The different kinds of epidermal expansions, mentioned above, are straight or curved thorn-shaped expansions, warts and hairs. The first of these (fig. 3) are straight, pointed and very thick walled, and form several longitudinal lines outside of the mesophyll and among the bulliform cells. The curved ones, pointing downward, are also thick walled and very sharply pointed; their base is surrounded by four similarly thickened cells, distinctly porose (figs. 4, 5 and 6) these expansions are also numerous, arranged in lines outside the groups of stereome. The warts (fig. 1.) are roundish, obtuse and solid projections, of which about fifteen are present on each epidermis cell, excepting, where the curved, thorn shaped expansions are found. They are covered with a distinct cuticula like the other expansions. Hairs (fig. 2) are also present, consisting of three thin walled cells, the apical not pointed. They form a few longitudinal rows outside the mesophyll, but close to the stereome.

Stomata are present in largest number on this, the inferior, face of the blade; they form usually two rows on each side of the lines of stereome, and are situated close together in regular alternation with each other. The stomata themselves are in the same plane as the epidermis cells and are surrounded only by some of the wart-shaped expansions.

we compare the epidermis of the inferior with that of the superior face, there is but slight difference. The bulliform cells, occupying the largest part of the latter, form groups between all the mestome bundles; the stomata are less numerous, forming only one row on each side of the stereome.

The mestome bundles represent three degrees in this species, the difference depending upon the following characters: a thick-walled mestome sheath in connection with a layer of similarly thickened parenchyma, separating the leptome from the hadrome, both of which being well differentiated, are characteristic of those of the first degree (fig. 9). These, the largest bundles, including the midrib, are by no means so numerous as the small ones, representing the second degree. These last have a distinct, but thin walled mestome sheath inside the colorless parenchyma sheath, and have no layer of thick walled parenchyma between the leptome and the hadrome. The smallest bundles (fig. 10) contain only leptome but show the mestome sheath very distinctly. Besides these three forms of mestome-bundles, all of which lie in the same plane, there are from one (fig. 7) to three (fig. 8) very small ones which belong to the superior face of the carene. It is a marked characteristic of Leersia that the leaf possesses such small mestome bundles on the superior face. If there is only one, this is, as shown in figure 7, situated exactly above the large midrib; when three are present, the median one of these occupies that place, as shown in the figure 8. Morever in the same figure the carene has two small bundles on the inferior face, one on each side of the large, median one, which makes this leaf have in all six nerves in the carene, while the other section (fig. 7) shows only two.

It is difficult to say whether this difference does or does not depend upon the locality. We can only state, that the specimen from which figure 7 was drawn, was collected near Washington, D. C., in a wet place, while the other (fig. 8) was taken from a specimen collected in Texas. Duval-Jouve[1] has figured a leaf of the same species, and his drawing agrees perfectly with figure 8, but he does not state whether his specimen was from Europe or frôm America.

By examining these small bundles from the superior face

[1] Histotaxie des feuilles de Graminées. Annales d. Sc. Nat. Botanique, Series VI, vol. 1. (1875.) p. 294.

of the carene, it is seen (fig. 11) that some of them are not surrounded by any parenchyma or mestome sheath, and that the leptome is well developed, the hadrome, on the contrary, being less differentiated.

In regard to the parenchyma sheath, which surrounds all the other mestome bundles in the blade, it is seen, in transverse section, to be composed of roundish and thin-walled cells containing chlorophyll, except in the median bundle and in a few bundles next this. The sheath forms a closed ring in the mestome bundles of second and third degree, while in the largest ones it is interrupted above and below by the groups of stereome.

Mention has been made of the presence of a mestome-sheath in the bundles of the leaf of this species of Leersia. This fact has also been recorded by Schwendener [2] who enumerates the species of Gramineæ containing the sheath, as examined by him. It may here be mentioned that this author has observed the presence of this sheath in *Oryza sativa* and *Zizania aquatica* as well as in *Leersia oryzoides* of the group ORYZEAE. There is often, however, some difficulty in deciding whether such thick-walled sheaths are to be considered as mestome sheaths or not. In the case of *Uniola* (l. c.) it seems probable that there is no mestome sheath. But in regard to *Distichlis*, and the so-called *Uniola Palmeri*, which, as stated before (l. c.), ought not to be separated from *Distichlis*, these two plants seem to have true mestome sheaths. That this character was not attributed to them in the anatomical diagnosis lately given [2] was due to the fact that the small mestome bundles showed a distinct interruption of this sheath. Prof. Schwendener (*in litteris*) has kindly informed me that he considers it to be a true mestome sheath, even if it is broken in the smallest bundles, which, according to his very welcome criticism, is rather seldom. From this fact there seems to be a stronger reason for uniting *Uniola Palmeri* with the genus *Distichlis*, since both have typical mestome sheaths besides the other characters they have in common.

The stereome is quite strongly developed in Leersia oryzoides, and forms groups above and below all the mestome

[2] Die Mestomscheiden der Gramineenblaetter, p. 413.

[2] BOTANICAL GAZETTE, August and October 1891.

bundles, situated in the lateral parts of the blade; the bundles of the carene form an exception, as seen in the figures 7 and 8: the large median nerve having no stereome on its hadrome-side. The same peculiarity is also found in the small bundles next the median (fig. 8). The three small mestome bundles, situated on the superior face of the carene (fig. 8) have merely stereome on their hadrome side, while the leptome shows only a small layer of stereome cells or none at all. One large isolated group of stereome is to be found in the outermost margin of the blade.

The mesophyll forms a dense tissue without any lacunes, and occupies a rather large part of the blade, as separate groups between the nerves. The mesophyll is in the carene restricted to the superior part of this, while a considerable layer of stereome covers the inferior face, the center part being occupied by a colorless parenchyma of considerable development.

U. S. Dep't of Agriculture, Washington, D. C.

Explanation of Plate XXI.—Sections of the leaf of *Leersia oryzoides.*—Fig. 1. An epidermis cell of the inferior face of the blade, showing the roundish, wart-shaped expansions. × 400.—Fig. 2. Hair from the inferior face. × 400.—Fig. 3. Thorn-shaped expansion from the bulliform cells of the inferior face. × 400.—Fig. 4.—A curved thorn-shaped expansion from the inferior face; longitudinal section. × 400.—Fig. 5. The same seen from the front. × 400.—Fig. 6.—The same, transverse section. × 400.—Fig. 7. Transverse section of a part of the blade, including the carene. *J*, the inferior face; *BC*, the bulliform cells. The specimen from which this section is taken was collected near Washington, D. C. × 75.—Fig. 8. Similar section, but from a specimen collected in Texas. × 75.—Fig. 9. Transverse section of one of the largest mestome bundles. There is, besides, a chlorophyll bearing parenchyma sheath *(P)*; a thick-walled mestome sheath *(MS.)*, which surrounds the leptome and the hadrome. *S*, the stereome. *J*, the inferior face of the blade. × 320.—Fig. 10. Transverse section of a small mestome bundle from the lateral part of the blade. Letters as above. The parenchyma sheath is colorless and thin-walled, like the mestome sheath. *SF.*, the superior face of the blade. × 400.—Fig. 11. Transverse action of a small mestome bundle situated on the superior face of the carene. × 320.—Fig. 12. A part of the leptome of the midrib, showing the sieve tubes *(ST.)* and the companion cells *(C)* in transverse section. × 400.

Popular American plant names.

FANNIE D. BERGEN.

[At the request of the author and from plates kindly furnished by the editor of the *Journal of American Folk-lore*, Mr. W. W. Newell, the following is reprinted from that journal, both because of its intrinsic interest to botanists and for the sake of assisting the author in getting a more complete list of well authenticated local names. In this endeavor our readers are urged to coöperate, by sending such names to Mrs. Fannie D. Bergen, 17 Arlington st., North Cambridge, Mass.—EDS.]

THE following list of names of common wild and cultivated plants has been prepared in the hope that it may suggest to folk-lorists who have some acquaintance with botany the importance of recording and communicating such names as may come to their knowledge. This work has been very thoroughly done in Great Britain; it is time that something like it should be attempted for our own flora.

In some cases, when I have taken the name from some one's description, there has been uncertainty as to the species, although there was no doubt about the genus; so that, in a few instances, I have only been able to give the latter.

It is interesting to notice the part certain nouns, used as adjectives or in composition, play in popular plant-names. *Horse*, *cow*, and *bull* have been generally used to designate unusually large and luxuriantly growing species, as the bull-thistle or horse-mint, or they are applied to coarse, common plants, as the horse-radish, the cow-lily. *Dog*, *pig*, or *sow* generally seems to carry the idea of commonness, as dog-fennel, pig-weed, sow-thistle. *Goose* and *toad* are less frequently used in much the same sense, *e. g.* goose-grass, toad-flax. The word *Indian* we find in constant use to distinguish wild species from those tame or more familiar ones which they somewhat closely resemble. *Mollugo verticillata* is thus called Indian chickweed, to distinguish it from the omnipresent common chickweed, *Stellaria media*, which is naturalized from Europe. Not infrequently the "Indian" namesake of some well-known plant may be used as at least a nominal substitute for the latter, *e. g.* Indian tobacco, *Antennaria plantaginifolia*, is chewed by children. Now and then, hints and traditions of the use of certain plants in the rude medical practice of our Indians may have resulted in fastening the name Indian to that of these plants, and it is evident enough that the Indian rice, *Zizania aquatica*, owes the first part of its popular name to the great importance which some tribes attached to it as an article of food.

The word *snake* plays an interesting part, too, in our popular botanical vocabulary. In general, "snake" indicates a plant supposed to be poisonous, or one which exerts a malign influence, yet sometimes it is applied to a plant that is thought to act as an antidote to the venom of snakes. A botanist from St. Stephen, N. B., writes: "Almost any unfamiliar berry is or may be snake-berry, and all snake-berries are poisonous; so a boy dares not eat a berry till some one tells him that it is good. Hence, though no two agree as touching the identity of the snake-berry, the name is very common." I find, too, curiously enough, that "snake" is sometimes used by a people no less widely removed from us than the Japanese to designate fruit unfit to be eaten by man. For instance, a beautiful large red fruit much resembling the strawberry, but whose flavor is perfectly insipid, is popularly called snake-berry, signifying that it is only fit food for snakes. Our popular name of Devil's apron for the familiar kelp, *Laminaria longicruris*, doubtless arises from the giant size of some of these plants, and I am told that in Japan this prefix sometimes designates an unusually large species. For instance, a monstrous thistle is called devil-thistle. Also a large variety of the particular rhomboidal-shaped Chinese nuts called hishi are popularly known in Japan as devil-hishi. However, with the Japanese as with us, *devil* may mean "armed," or uncanny in appearance, as the "devil-lotus," one with very prickly leaves. Our well-known prickly pear, *Opuntia Rafinesqii* or *O. vulgaris*, when cultivated in northern Ohio, is somewhat generally known as devil's tongue, which must seem a most fitting name to any one who has imprudently filled the tips of his fingers with the insinuating barbed bristles.

As a rule, I have here entered only such popular names of wild plants as are not recorded in the new edition of Gray's Manual. Wood's Botany contains some of those that I have collected from various parts of the country, but such as I have here retained as are found in either of these floras are given for the sake of designating special localities for such names, or because of some note that seemed worth appending.

In those instances in which I have given as locality only the name of the State, it is either because the name is known to be in use in various parts of the State, or because my informant could not give the county or town. Some names given are such as were certainly current a good many years ago in the localities cited, but have not been verified as still existent there. It would often have been very difficult to make inquiries about the present currency of these names; hence they have been allowed to stand as probably still in use.

RANUNCULACEÆ.

Clematis Virginiana, traveller's joy; wild hops. N. H.
devil's darning needle. So. Vt.
Anemone nemorosa, wild cucumber. N. H.
Mayflower. Boston.
Hepatica triloba, mouse-ears. Mason, N. H.
Mayflower. Hemmingford, P. Q.
Anemonella thalictroides, wind-flower. Mansfield, O.
Thalictrum polygamum, rattlesnake-bite. N. H.
muskrat-weed; musquash weed. Southbridge, Mass.
Thalictrum dioicum, shining grass.[1] Weathersfield, Vt.
Ranunculus (double garden buttercups), golden daisies. Richland Co., O.
Ranunculus aquatilis, var. *trichophyllus*, moss (gives name to "Moss Creek," Carroll Co., Mo.).
Caltha palustris, May-blobs. Salem, Mass.
coltsfoot. Stratham, N. H.
Coptis trifolia, yellow-root. N. H.
Nigella Damascena, love-in-a-mist; lady-in-the-green. N. E. and Westward.
lady-in-a-chaise. N. H.
devil-in-a-bush. Northern Ohio.
St. Catherine's flower. (Locality?)
ragged lady. Wisconsin.
Aquilegia Canadensis, honeysuckle. N. E.; Peoria, Ill.
rock-lily. Mason, N. H.
cluckies. Annapolis Co., N. S.
meeting-houses. New England.
Aconitum Napellus, Venus' chariot.[2] Brookline, Mass.
Actæ spicata, var. *rubra*, snake-berry. Belleisle, N. B.

NYMPHÆACEÆ.

Nelumbium luteum, chinquapins. Carroll Co., Mo.
Nuphar advena, cow-lily. Washington Co., Me.
dog-lily. New England.
beaver-lily. Me.
bull-head lily. N. H.
ducks.[3] Chestertown, Md.

[1] See, also, *Impatiens*. The name is given because of the silvery appearance of the leaves when immersed in water.
[2] The swans are hidden in the hood.
[3] Quy. *docks*, as in spatter-dock?

SARRACENIACEÆ.

Sarracenia purpurea, Adam's cup. Dudley, Mass.
foxglove. N. H.
Indian pitcher. N. B.

PAPAVERACEÆ.

Eschscholtzia, California poppy. General.
cups-of-flame. New England.
Papaver (a small species), coquettes.[1] Mansfield, O.
Argemone Mexicana, bird-in-the-bush. Arlington, Mass.
flowering thistle. Mansfield, O.
Sanguinaria Canadensis, snake-bite. N. H.

FUMARIACEÆ.

Adlumia cirrhosa, Alleghany vine. N. Ohio.
mountain fringe. So. Vt.; E. Mass.
fairy creeper. Fredericton, N. B.
Dicentra spectabilis, diethra. Mass.

CRUCIFERÆ.

Lepidium Virginicum, birds' pepper. Nebraska.
Capsella bursa-pastoris, pepper-plant. Allston, Mass.

VIOLACEÆ.

Viola palmata, var. *cucullata*, hood-leaf violet. Franklin, Mass.
Viola (sp. unknown), rooster hoods. Buncombe Co., N. C.
Viola sagittata, spade-leaf violet. Franklin, Mass.
Viola Canadensis, June flower. Woodstock, N. B.; Houlton, Me.
Viola tricolor, lady's delight. Mass.
Cupid's delight. Salem, Mass.
Johnny-jump-up.[2] O. and Ill.
Viola pedata, horseshoe violet. Concord, Mass.
Crowfoot violet. New England.
horse violet. New England.

DROSERACEÆ.

Drosera rotundifolia, eye-bright. N. H.

CARYOPHYLLACEÆ.

Dianthus barbatus, bunch pink. Vt.; So. Ohio.
Saponaria officinalis, old maid's pink; London pride. Salem, Mass.
woods phlox. N. J.

[1] French *coquelicot*.

[2] In Mansfield, Ohio, this name is commonly abbreviated into Johnnies, and this nickname is often applied by children to the common wild blue violet.

Silene cucubalus, snappers. Salem, Mass.
Silene Armeria, wax-plant. Mansfield, O.
sweet Susan. N. H.
none-so-pretty. Hatfield, Mass.
pretty Nancy. Franklin Center, P. Q.
Silene noctiflora, gentlemen's hats. Gilsum, N. H.
Lychnis Githago, old maid's pink. N. H.
mullein pink. Annapolis Valley, N. S.
Lychnis chalcedonica, sweetwilliam. Weathersfield, Vt.; So. Ohio.
fire-balls. Mansfield, O.
scarlet lightning.[1] Hemmingford, P. Q.

PORTULACACEÆ.

Portulaca oleracea, pusley. U. S.
Portulaca grandiflora, Mexican rose. Chestertown, Md.
rose-moss. So. Nebraska.
French pusley. So. Vt.
Claytonia Virginica, good-morning-spring. (Locality ?)
wild potatoes. Union Co., Pa.
Mayflower. Hemmingford, P. Q.

MALVACEÆ.

Abutilon Avicennæ, butter-weed. Peoria, Ill.
sheep-weed; Mormon-weed; velvet-weed. Quincy, Ill.
button-weed. Chestertown, Md.
Abutilon striatum, flowering maple. Mansfield, O.
Malva rotundifolia, cheeses, or cheese-plant. U. S.
Malva moschata, musk-plant or musk. Mansfield, O.
Hibiscus trionum, black-eyed Susan. N. H.; N. B.
devil's-head-in-a-bush. N. H.

GERANIACEÆ.

Geranium maculatum, chocolate-flower. Stratham, N. H.
Pelargonium (common pink and white species or var.), apple geranium. Mansfield, O., and parts of Mass.
Oxalis stricta, ladies' sorrel. Allston, Mass.; Stratham, N. H.
Impatiens fulva, snap-dragon. N. H.
snap-weed. N. B.
kicking colt. E. Mass.
shining grass.[2] Weathersfield, Vt.

[1] Probably a corruption for *Lychnis*.
[2] See note on *Thalictrum dioicum*.

balsam-weed ; slipper-weed ; lady's ear-drop. Mansfield, O.
lady's slipper. Plattsburg, N. Y. ; Mansfield, O.
lady's pocket. Mansfield, O.

Impatiens balsamina, lady's slipper. Mansfield, O.

ILICINEÆ.

Nemopanthes fascicularis, brick-timber ; cat-berry.[1] Fortune Bay, Newfoundland.

CELASTRACEÆ.

Celastrus scandens, Roxbury wax-work. E. Mass.
Jacob's ladder. Stratham, N. H.

Euonymus atropurpureus, Indian arrow. Salem, Ind.

Pachystima Canbyi, rat-stripper. N. J.

VITACEÆ.

Vitis cordifolia, chicken grapes. Chestertown, Md.

ANACARDIACEÆ.

Rhus glabra, shoe-make. Ohio and Ill.

Rhus toxicodendron, black mercury. Harmony, Me.
mercury or markry. N. H.
mark-weed. Kennebec Co., Me.

POLYGALACEÆ.

Polygala paucifolia, babies' feet. N. H.
babies' toes. Hubbardston, Mass.

LEGUMINOSÆ.

Crotalaria (*ovalis ?*), rattlesnake-weed. Mansfield, O.

Genista tinctoria, wood-wax. Essex Co., Mass.[2]

Lupinus perennis, wild pea. Worcester Co., Mass.

Lupinus villosus, monkey faces ; sun-dial.[3] N. Ohio.

Trifolium pratense, "real sweet clover." Mass. and parts of Me.

Amorpha canescens, shoestrings. Ill.

Apios tuberosa, traveller's delight. New Albany, Miss.
wild bean. N. B.

Phaseolus multiflorus, flower bean. Mansfield, O.

[1] This, like most of the other names quoted from Newfoundland, is taken from Rev. A. C. Waghorne's *Wild Berries and other Edible Fruits of Newfoundland and Labrador.*

[2] In this its principal American locality, the plant is never called wood-waxen, or any other name than that above given.

[3] So called from the monkey-like profile of the seed.

Arachis hypogæa, ground-nut. Chestertown, Md.
goobers. Southern.
pinders. Miss.
ground-peas. Ky.
Schrankia uncinata, sensitive rose. West and South.
Schrankia sp., shame-vine. N. Miss.

ROSACEÆ.

Prunus serotina, rum-cherry.[1] N. E.
Prunus Americana, wild goose plum. Chestertown, Md.
Prunus hortulana, wild goose plum. Markets of Boston and elsewhere.
Prunus maritima (?), mountain cherry. Chestertown, Md.
Spiræa sp., spice hard-hack. Bonny River, N. B.
Rubus odoratus, mulberry; Scotch caps. Hemmingford, P. Q.
Rubus chamæmorus, baked apples. New Brunswick and Grand Manan Id.
bake-apple-berry. Grand Manan.
Rubus triflorus, mulberry. Washington Co., Me.; N. B.
dewberry. N. B.
plumbog. Newfoundland.
swamp-berry. Newfoundland.
Rosa cinnamomea, kitchen rose. Boston, Mass.
Pyrus arbutifolia, dog-berry. N. E.
choke-pear. Washington Co., Me.
Pyrus Americana, witch-wood.[2] N. H.
round-tree (for rowan-tree). N. B.
dog-berry. Newfoundland.
missey moosey. N. H.
Cydonia Japonica, scarlet thorn. Chestertown, Md.
flowering quince. O., and somewhat general.
Cratægus, thorn-apple. Mansfield, O.
Amelanchier Canadensis, June berry. Various parts of N. E. and Central States.
sugar plum; shad-blow. N. H.
sugar pear. Washington Co., Me.
juice-pear or juicy pear. Provincetown, Mass.
May-pear.[3] N. B.

[1] From its use in flavoring "cherry rum." In the W. and S. whiskey is used with these cherries to make "cherry bounce."
[2] If carried, supposed to keep off witches.
[3] From time of blooming.

SAXIFRAGACEÆ.

Saxifraga Virginiensis, Mayflower. Allston, Mass.
Ribes prostratum, skunk currant.[1] Washington Co., Me.
Ribes aureum, flowering currant. General.
clove currant. Cambridge, Mass.

CRASSULACEÆ.

Sedum acre, love entangled. N. Ohio.
Sedum (*pulchellum?*), flowering moss. Mansfield, O.
Sedum Telephium, witches' money-bags. W. Mass.
evergreen. Chestertown, Md.
everlasting. Hemmingford, P. Q.
Aaron's rod. New Hampshire.
frog's mouth; frog's bladder. N. Y.
pudding-bag plant. Mass.
leeks. Stowe, Vt.
frog-plant.[2] N. H.
frogs' throats. Bedford, Mass.
Sempervivum tectorum, hen and chickens. N. Ohio.
Bryophyllum calycinum, life-plant. Cambridge, Mass.

ONAGRACEÆ.

Œnothera fruticosa, scabbish. N. H.

CUCURBITACEÆ.

Lagenaria sp., mock orange. N. Ohio; Central Ill.
Echinocystis lobata, wild cucumber. N. B., and U. S. generally.

BEGONIACEÆ.

Begonia metallica, elephant's ears. Bedford, Mass.
Begonia maculata, trout begonia. Bedford, Mass.
fish begonia. Cambridge, Mass.
Begonia Warscewiczii, pond-lily begonia. Cambridge, Mass.
Begonia sp. (similar to *B. maculata*, but not spotted), coral begonia. Bedford, Mass.
Begonia sp., beefsteak geranium. Mansfield, O.
strawberry geranium. Mansfield, O.

CACTACEÆ.

Opuntia Rafinesqii, or *O. vulgaris*, devil's tongue. N. Ohio.

[1] From the offensive musky smell of the fruit.

[2] Because of a children's custom of blowing up a leaf so as to make the epidermis puff up like a frog.

FICOIDEÆ.

Mesembryanthemum sp., dew plant. N. Ohio.
rat-tail pink. Dorchester, Mass.

UMBELLIFERÆ.

Daucus carota, parsnip. Harmony, Me.
Erigenia bulbosa, turkey-pea. (Locality ?)

ARALIACEÆ.

Aralia racemosa, Indian root ; life of man ; petty morrell. N. H.
spignut. Vt.

CORNACEÆ.

Cornus Canadensis, bunch plums ; pudding-berry.[1] N. H.
pigeon-berry. N. B.
cracker-berry.[1] Newfoundland.
Cornus stolonifera, red-brush. Central States.
Nyssa sylvatica, hornbeam. N. H.

CAPRIFOLIACEÆ.

Viburnum lantanoides, moosewood. Mass.
Viburnum opulus, high-bush cranberry. Washington Co., Me., and N. B.
witch-hobble. N. H.
Viburnum nudum, withe-wood. N. H.
bilberry. Annapolis Royal, N. S.
Linnæa borealis, two-eyed berries. St. Stephen, N. B.
Symphoricarpus racemosus, snow-drop. Mansfield, O.

RUBIACEÆ.

Houstonia cærulea, blue-eyed babies. Springfield, Mass.
Quaker ladies. Concord, Mass. ; Boston.
innocence. Boston, Mass.
eyebright. Isles of Shoals.
angel-eyes. (Locality ?)
bright-eye. Baltimore, Md.
forget-me-not. Kentucky.
star of Bethlehem. Miss.
Quaker beauty. (Locality ?)
Nuns. (Locality ?)
Cephalanthus occidentalis, pin-ball. N. H.

[1] Probably from its insipid character.

Mitchella repens, squaw-vine. Parts of N. E.
snake-berry. N. Y.
cow-berry. Ulster Co., N. Y.
boxberry. Bedford, Mass.
two-eye-berry. Wakefield, Mass.

COMPOSITÆ.

Eupatorium purpureum, motherwort. Brookfield, Mass.
Queen-of-the-meadow. Worcester Co., Mass.
marsh milkweed. Mass.
Solidago (any sp.), yellow-tops. N. B.
Callistephus Chinensis, fall roses. Mansfield, Ohio.
Aster (any sp.), frost-flowers. N. B.
Erigeron Canadense, cow-tail. Normal, Ill.
Antennaria plantaginifolia, Indian tobacco. N. E.; Neb.
woman's tobacco. Boston, Mass.
ladies chewing tobacco. Wisconsin.
pussy's toes. Worcester, Mass.
dog toes. N. H.
Anaphalis margaritacea (?), life-of-man. N. H.
Gnaphalium polycephalum, life everlasting. N. E.; No. Ohio.
old field balsam. N. E.
life-of-man. Stratham, N. H.
fuzzy-guzzy. Mansfield, O.
feather-weed.[1] No. New York.
Ambrosia artemisiæfolia, tassel-weed. Hingham, Mass.
Zinnia elegans, youth-and-old-age. Mansfield, O.
Rudbeckia hirta, yellow daisies. Mass., N. B., and general.
golden Jerusalem. N. H. (local).
black-eyed Susans. N. Vt.; Cape Cod.
nigger-heads. (Name apparently brought from So. U. S.) N. B.
nigger daisy. E. Mass.
Coreopsis tinctoria, Rocky Mt. flower. Mansfield, O.
Bidens (all species), Spanish needles. Ill., and Central States generally.
Anthemis cotula, dog-fennel. General.
pigsty daisy. Ipswich, Mass.
Chrysanthemum leucanthemum, pismire. East Weymouth, Mass.
bullseye. N. B.

[1] Name given because the heads were used by poor people to fill beds, as a substitute for feathers.

Artemisia abrotanum, boy's love;[1] lad's love.[1] Various parts of New England.
old man.[1] Ohio; Ill.
Leamington. Ipswich, Mass.
Artemisia sp., old woman.[1] N. Ohio.
Xeranthemum, *Helichrysum*, } paper-flowers. N. Ohio.
Cnicus pumilus, bull-thistle. New England.
Cnicus (any species), stickers. St. John, N. B.
Cichorium Intybus, blue dandelion. N. H.
blue sailors. Brooklyn, N. Y.
Leontodon autumnalis, arnica. E. Mass.
Lactuca (any species), milkweed. N. B.

LOBELIACEÆ.

Lobelia cardinalis, slink-weed. Princeton, Mass.

ERICACEÆ.

Gaylussacia (all species), black hurts.[2] Newfoundland.
Vaccinium (many species), whortleberry; bilberry. Newfoundland.
any low blueberry; ground-hurts. Newfoundland.
Vaccinium (any species under sub-genus Cyanococcus), bluets. N. B., among French Canadians.
Vaccinium Oxycoccus, marsh cranberry. N. B.
marshberry. Newfoundland.
Vaccinium macrocarpon, marsh cranberry. N. B.
bearberry; bankberry. Fortune Bay, Newfoundland.
Vaccinium Vitis-Idæa, rock cranberry. N. B.
Chiogenes serpyllifolia, ivory plums. Washington Co., Me.
capillaire; maiden-hair;[3] teaberry. New Brunswick.
Arctostaphylos uva-ursi, crowberry. Barnstable, Mass.; Kinnikinnik, Newfoundland.
rockberry. Fortune Bay, Newfoundland.
Epigæa repens, shad-flower. Conn.

[1] Names apparently given from supposed aphrodisiac qualities, or because used in love divinations.

[2] "Hurts" is an abbreviation for "whortleberry."

[3] This name, attached to a description of the plant, was the occasion of an indignant protest by a botanist in England at the idea of the maidenhair (fern) being supposed to flower and fruit in New Brunswick!

Gaultheria procumbens, young plantlets; drunkards.[1] Barnstable, Mass.
youngsters.[2] Me.; Mass.
jinks or chinks. N. H.; Mass.
young chinks. Mason, N. H.
pippins.[3] Stratham, N. H.; Central Mass.
young ivories; ivory plums. N. H.
ivory leaves; ivory plums. Ipswich, Mass.; Me.
mountain tea. Eastern Ohio.
ivy-berry. N. B.
deer-berry. (Locality?)
one-berry. (Locality?)
chicken-berry. Penn.

Kalmia latifolia, spoon-hunt. Mason, N. H.

Kalmia angustifolia, sheep-poison. N. E.
spoon-wood ivy. Conn.

Rhododendron viscosum, swamp-pink. Allston, Mass.

Rhododendron nudiflorum, election pink. Hillsborough, N. H.
river pink. Cavendish, Vt.
swamp pink. Parts of N. E.
swamp apple. E. Mass.
honeysuckle. Md.

Rhododendron Rhodora, lambkill. N. B.

Chimaphila umbellata, noble pine; bittersweet. N. H.
love-in-winter. Maine.

Chimaphila maculata, ratsbane; wild arsenic. Blue Ridge, Va.

Monotropa uniflora, convulsion-root. N. H.
ghost-flower. N. B.

DIAPENSIACEÆ.

Pyxidanthera barbulata, pyxie moss. N. J.

PRIMULACEÆ.

Primula grandiflora, polyanthus. So. Vt.; Cambridge, Mass.; Mansfield, O.
cups-and-saucers. Mansfield, O.

Trientalis Americana, Star-of-Bethlehem. N. H.
star anemone. Cambridge.

APOCYNACEÆ.

Vinca minor, myrtle. General.

[1] Believed by children to intoxicate.
[2] Young berries and shoots.
[3] Young leaves.

ASCLEPIADACEÆ.

Asclepias tuberosa, white root; yellow milk-weed. W. Mass.

GENTIANACEÆ.

Gentiana Andrewsii, blind gentian. Haverhill, Mass.

POLEMONIACEÆ.

Phlox pilosa, sweetwilliam. Fort Worth, Tex.
Phlox subulata, flowering moss. No. Ohio.
Phlox, cult. sp., Lady Washington. Mansfield, O.
Polemonium reptans, bluebell. Mansfield, O.

BORRAGINACEÆ.

Cynoglossum officinale, sheep-lice. No. Ohio.
Echinospermum Virginicum, soldiers. E. Mass.

CONVOLVULACEÆ.

Convolvulus sepium, creepers. Mansfield, O.
Rutland beauty. Temple, N. H.
Cuscuta sp., love-vine. Fort Worth, Tex.

SOLANACEÆ.

Datura Stramonium, } Jimson or Jimpson[1] weed. W. and S.
Datura Tatula, }
Lycium vulgare, privy; Jackson vine; jasmine. Mansfield, O.
jessamine. Stratham, N. H.

SCROPHULARIACEÆ.

Linaria vulgaris, Jacob's ladder. Parts of N. E.
bread-and-butter. Ipswich, Mass.
dead men's bones. Troy, N. Y.
Antirrhinum majus, lion-mouth. Mansfield, O.
Chelone glabra, bammany (for balmony?). Belleisle, N. B.
Gerardia quercifolia (?), corn-flower. Hillsborough Co., N. H.
pedicularia (?)
Castilleia coccinea, paint-brush. Peoria, Ill.; N. H.; Hemmingford, P. Q.
Indian paint-brush. Mass.
Red Indians. Mass.
Wickakee.[2] Mass.
election posies. Dudley, Mass.
prairie fire. Wisconsin.

[1] Evidently a corruption of Jamestown, where the plant is most abundant. This corrupted form of the name is universal.
[2] An Indian name.

BIGNONIACEÆ.

Tecoma radicans, foxglove. Chestertown, Md.

VERBENACEÆ.

Verbena stricta, fever-weed.[1] Peoria, Ill.

LABIATÆ.

Nepeta Glechoma, Robin runaway. N. H.
creeping Charlie; Jack-over-the-ground; Gill-over-the-ground. E. Mass.
wild snake-root. Cambridge, Mass.
crow-victuals.[2] Chestertown, Md.
Brunella vulgaris, carpenter-weed. N. H.

NYCTAGINACEÆ.

Mirabilis Jalapa, pretty-by-night. Fort Worth, Tex.

AMARANTACEÆ.

Gomphrena globosa, French clover. No. Ohio.
globes. So. Vt.

CHENOPODIACEÆ.

Salicornia herbacea, chicken's toes. Kittery, Me.

POLYGANACEÆ.

Rheum Rhaponticum, pie-plant. General in Middle States and westward.
Rumex acetosella, horse-sorrel. Mansfield, O.
toad's sorrel. Stratham, N. H.
cow-sorrel.[3] Miramichi, N. B.
gentlemen's sorrel. Cambridge, Mass.
sheep-sorrel. Wisconsin; So. Vt.
Polygonum aviculare, wire-grass. No. Ohio.
door-grass. So. Ind.
Polygonum acre, turkey-troop. Long Island, N. Y.

EUPHORBIACEÆ.

Euphorbia maculata, milkweed. No. Ohio.
Euphorbia marginata, Snow-on-the-mountains. N. H.; Neb.
Euphorbia Cyparissias, tree-moss. Mansfield, O.
cypress. Rye Beach, N. H.
butternut. Harmony, Me.
Irish moss. N. B.

[1] Thought to be a specific for fever and ague.
[2] Name used by the negroes. [3] Usually pronounced "cow-serls."

Euphorbia Lathyris, mole-tree.[1] No. Ohio.

JUGLANDACEÆ.

Carya tomentosa, bull-nut. Peoria, Ill.

MYRICACEÆ.

Myrica cerifera, candle-berry. Worcester Co., Mass.

CONIFERÆ.

Larix Americana, Juniper-tree. Newfoundland.
Juniperus communis, hackmatack. Ipswich, Mass.
fairy circle. E. Mass.
Juniperus sabina, var. *procumbens*, savin.[2] Newfoundland.

ORCHIDACEÆ.

Arethusa bulbosa, dragon's mouth. Dudley, Mass.
Habenaria orbiculata, Solomon's seal. Barre, Vt.
Habenaria fimbriata, meadow pink. Mass.
Cypripedium acaule, nerve-root. N. B.
whip-poor-will. Boston, Mass.
Cypripedium spectabile, nerve-root. N. B.
whip-poor-will shoes. Conn.

SCITAMINEÆ.

Canna Indica, adder's spear. Waltham, Mass.

AMARYLLIDACEÆ.

Narcissus Pseudo-Narcissus, Easter-flower. Mansfield, O.
daffy. Stratham, N. H.
Narcissus poeticus, single daffy. Stratham, N. H.

IRIDACEÆ.

Iris pumila, crocus. Stratham, N. H.
Iris versicolor, poison flag.
flag-lily.
water-flag. [3]
liver-lily.
snake-lily.
Belamcanda Chinensis, dwarf tiger-lily. Mansfield, O.

[1] Supposed to keep moles out of gardens.
[2] The berries used in domestic medicine, and called face-and-eye berries.
[3] These names are taken from Hobbs' *Botanical Handbook*.

LILIACEÆ.

Smilax rotundifolia, biscuit-leaves; bread-and-butter.[1] Allston, Mass.
wait-a-bit.[2] E. Mass.
nigger-head. Miramichi, N. B.
Muscari botryoides, baby's breath. E. Mass.
bluebell. Chestertown, Md.
bluebottle. Mansfield, O.
Yucca filamentosa, thread-and-needle. Mass.; N. Y.
Eve's darning needle. Fort Worth, Texas.
Maianthemum Canadense, cowslip. Dennysville, Me.
lily-of-the-valley; two-leaved Solomon's seal. N. H.
Clintonia borealis, cow-tongue. Aroostook Co., Me.; N. B.
heal-all. N. B.
Oakesia sessilifolia, wild oats. N. H.
Lilium superbum, nodding lilies; Turk's head. Mass.
Erythronium Americanum, yellow bells. Boston (?).
Trillium erectum, dish-cloth or stinking dish-cloth. Franklin Center, P. Q.
bumble-bee root. New England.
squaw-root. N. H.
Benjamins. So. Vt.
stinking Benjamin. N. B. (Any Trillium in N. B. is called Benjamin.)
Trillium grandiflorum, white lilies. No. Ohio; Chestertown, Md.
Trinity lily. Wisconsin.
Trillium erythrocarpum, Benjamins. New England.

COMMELINACEÆ.

Tradescantia crassifolia, wandering Jew. General.
inch-plant. Salem, Mass.
joint-plant. Cambridge, Mass.
Jacob's ladder. Hemmingford, P. Q.

ARACEÆ.

Arisæma triphyllum, bog onion. Worcester Co., Mass.
wild turnip. Stowe, Vt.
Jack-in-the-pulpit. General.
Symplocarpus fœtidus, Polk-weed (poke weed?). Brookline, Mass.

[1] The young leaves eaten by children.
[2] On account of the difficulty of tearing loose clothing caught by its stout prickles.

GRAMINEÆ.

Cenchrus tribuloides, sand-burr. Ill. and westward.
Zea mays, a species of pop-corn, with variegated ears; guinea-corn.[1] Mansfield, O.
yellow kernels, striped with red; calico corn. Ill.
long, indented kernels; dent corn. General.
horse-tooth corn. Central Ill.

FILICES.

Pteris aquilina, hog-brake. N. H.
Osmunda regalis, buck-horn. Worcester Co., Mass.
Osmunda cinnamomea, fiddle-heads.[2] Central Me.
Osmunda sp., fiddle-heads. Petit Codiac, N. B.

LYCOPODIACEÆ.

Lycopodium clavatum, coral evergreen. Stratham, N. H.
creeping Jenny. N. B.
Lycopodium dendroideum, bunch evergreen. Stratham, N. H.
crowfoot. Chestertown, Md.
Lycopodium complanatum, creeping Jenny. Bedford, Mass.
liberty. Chestertown, Md.
ground-cedar. N. B.

MUSCINEÆ.

Polytrichum commune, bears' bread. Dennysville, Me.
rum-suckers.[3] Stratham, N. H.
Bryum sp., robin-wheat. Mansfield, O.

FUNGI.

Hymenomycetes (any umbrella-shaped species), devil's umbrellas. Baltimore, Md.
Phallus sp., death-baby.[4] Salem, Mass.
Ustilago Maydis (the smut of Indian corn), Devil's snuff-box. Chestertown, Md.
Cladonia bellidiflora (a common lichen), red-cup moss. General in N. E.

[1] Because speckled like a guinea-fowl.

[2] Under this name the unrolling fronds considerably sought and eaten as "greens."

[3] So called from the supposed spirituous taste of the pasty mass of unripe spores.

[4] Name given from the fancy that they foretell death in the family near whose house they spring up. I have known of intelligent people rushing out in terror and beating down a colony of these as soon as they appeared in the yard.

Usnea sp. (a tufted hair-like lichen), whisker-moss. Mansfield, O.

ALGÆ.

Laminaria (*saccharina ?*). Venus's apron-strings. Brookline, Mass.
Laminaria longicruris, Devil's apron-strings; Deb's apron-strings. Portland, Me.
Devil's apron. N. E. coast.
Spirogyra and allied confervaceae, frog-spit. U. S.
frog-spawn. Parts of N. B

BRIEFER ARTICLES.

The systematic position of Entosthodon Bolanderi.—In February, 1889, Dr. Edward Palmer, collecting in Lower California for the Department of Agriculture, found this species in thevicinity of Port San Quentin, about a hundred miles south of San Diego. This greatly extends southward the range of this species. It looks much like *Funaria Californica* Sulliv. & Lesq., in outward appearance, but differs from it in the more acuminate leaves, in the capsule more long-necked and constricted under the orifice when dry and in the mamillate lid. Closer examination of the plants, which are in excellent condition, shows furthermore only a rudimentary peristome; the costa ceases above the middle of the leaf; the cells near the apex of the leaf are more elongated.

A search in the material of the closely allied genus Entosthodon led to the discovery of this identical species under the name of *Entosthodon Bolanderi* Lesq. The one specimen in the National Herbarium comes from the herbarium of Lesquereux himself, and is labelled: "*Entosthodon Bolanderi* Lesq. Ad terram argillosam, prope San Francisco, Californiæ. No. 236. Leg. Bolander."

A comparison of Palmer's plants with this specimen, and with the figures in Sulliv. Icon. Suppl. t. 17, shows them to *agree* in all respects, except that the figure and description make no reference to the *inner rudimentary* peristome, distinctly present in the specimens of Lesquereux collected by Bolander, as well as in Palmer's specimens. This peristome is as pronounced as in Funaria microstoma. In specimens of Funaria Californica in the National Herbarium, it is not nearly so well developed as figured in Sulliv. Icon. Suppl. t. 18, but is almost as

rudimentary as in the plants collected by Palmer. So that practically there remain only two prominent points of distinction between Funaria Californica and Entosthodon Bolanderi: the *lid*, being convex in the former and mamillate in the latter; and the *costa*, passing to the apex in the former, and only to about the middle in the latter.

The color of the peristome, described as "pale, whitish, granulose," is found in both the specimens of Bolander and those recently collected by Palmer, to be in fact *red, granulose, longitudinally striate*, and distinctly articulate. This discrepancy is quite likely due to the difference in maturity of the material examined. The calyptra, referred to in a note under the species in the Manual of N. A. Mosses as "five lobed at base and rather mitrate," is in Dr. Palmer's material usually split open down one side, and at base is more often three or four lobed, this lobing being rather irregular. The calyptra is thus on the whole as in Funaria. This, and especially the presence of an *inner* peristome, makes necessary the transfer of this species of Entosthodon to Funaria; it should be called **Funaria Bolanderi** (Lesq.).—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

A probable new category of carnivorous plants.—The fact that members of the genus Polyporus are in the habit of catching and digesting small insects is not generally known. At least after a careful examination of such literature as happens to be at hand, the writer is unable to discover any reference to what is a distinct and curious phenomenon in the life history of some of these large and interesting fungi. In Polyporus applanatus the method of catching and devouring the insects has been studied by me, and a brief description may be in place at the present time. Whether or not the habit alluded to has been described by other students I cannot yet be sure, but it is sufficiently unknown in American writings to permit of attention in these pages.

Polyporus applanatus (Pers.) Wallr. is common around Lake Minnetonka, where it occurs on its ordinary hosts, and also on *Tilia Americana* in considerable abundance. The large size — one-third of a meter in diameter — and the cinnamon-brown zonate upper surface, together with the light under surface and the minute pores make it a conspicuous object in the woods and swamps. This plant seems to exert an attractive influence over various species of small flies — especially when partly grown. The flies may be seen assembling in swarms upon the under surface of the plant, where they walk about and appear to feed upon the soft substance of the hymenophore. Mosquitoes and gnats, together with larger flies, may be found upon the under

surface in large numbers at certain times of the day, notably in the evening or towards the middle of the afternoon. I have not been able to discover any secretion that might be attractive to the insects given off by the plant, but there may be such.

In walking over the minutely perforated surface an occasional fly may be seen to get its feet caught between the clefts and is then unable to extricate itself. It shortly dies and lies flat upon the hymenophore surface. Whether the death is due to poisoning or simply to fatigue, I have not determined. At any rate there is very promptly sent up around the body of the insect a mycelial growth from the interior of the pores of the plant, and in a few hours the insect is completely covered by the fungus filaments. For a time it may be seen as a hummock or elevation on the hymenophore, but shortly, through the absorption of its substance into the tissue of the fungus, it disappears as an elevated area and is discernable solely through its imparting a slightly lighter color to the portion of the hymenium lying around it. I have in my collection one of these Polyporus fruits, about six inches in diameter, with seventeen small flies captured and digested — some of them so completely destroyed that there is scarcely more than a vague stain left to mark the spot where they lay, and others of a whitish hue and lying in high relief on the tinted lower surface. In the case of those that are thoroughly digested the plant produces pores afresh through the remains of their bodies, and the trace of their original presence becomes almost obliterated. Those that are partially digested are not penetrated by the pores but the mycelial covering is of a solid texture. It is quite like that of the border of the hymenophore. Nor do the penetrating pores appear until the flies are reduced almost to the level of the general hymenium surface.

This phenomenon is an interesting one, for it shows how a structure devised for another end may be devoted to an accessory line of work, and may in time come to acquire an accessory function. The Polyporus can not be conceived to derive very marked benefit from the small substance that it is able to obtain from the unfortunate flies, but it is easy to see how such a practice if persisted in might develop into a highly important nutritive habit. It is unquestionably true that the plant derives some nutriment from these flies, for where they fall and raise the level of the hymenium there are more pores produced than at other points of similar size. This would indicate that the habit of fly-catching which is practiced by the Polyporus applanatus might develop into something of real importance to the species.

I shall be glad to hear from others who have noticed this habit in Polyporineæ.— CONWAY MACMILLAN, *University of Minnesota.*

EDITORIAL.

A LIVE MAN is readily distinguished from a dead one, and if the man is alive to some important interest it needs no search light or committee of investigation to make the fact apparent. The statement applies no less forcefully to bodies of men than to individuals. At the recent meeting at Rochester a ninth part of the time occupied by the American Association for the Advancement of Science in its annual sessions was set apart to the exclusive control of the botanists by the establishment of a botanical section. This came about chiefly through the efforts of the non-botanical members of the society, who said that the botanists were so numerous and active, had so many and valuable papers, were such an important element, that it was their due; and so while mathematics and astronomy must share rooms, officers and time, as well as geology and geography and some other subjects, botany has an exclusive portion. It was evident to the Association that the botanists constituted a live body.

That this appearance of activity, which did not escape even those who probably possess but an indistinct notion of the domain of botany, is well grounded, was abundantly demonstrated during the sessions in numerous ways, and in none better than in the action upon the question of a stable nomenclature. In the most business like manner, and with an enthusiasm, directness and good feeling which would have done credit to any deliberative body, the question that for years has been supposed to endanger the rational progress of the science and in the hands of the more youthful and radical advocates threatened to plunge American botany into chaos, was taken up, discussed, the most important features formulated and agreed to, a delegate to the convention at Genoa appointed, the money to defray his expenses subscribed, and the mission to secure the co-operation of the botanists of Europe begun before the session at Rochester had closed. The results of the Congress at Genoa have been most satisfactory, and are especially flattering to the foresight and zeal of American botanists, whose views have received marked consideration.

There is, therefore, no reason to think that the botanists of this country cannot do well whatever they undertake. There is furthermore no reason to suppose that they will shirk a manifest responsibility; and yet they are dangerously near such a point. Whether they desired it or not, the impression has become widely established that a botanical congress will be held next year. The World's Congress Auxiliary attempted to secure the co-operation of the botanists, and offered them the use of the machinery of that organization, including

free publication of their proceedings, but the proposition has been rejected.

To be sure, a committee has been appointed to arrange a program of subjects for next year's meeting at Madison. But no enthusiasm has yet manifested itself. It is, however, certainly true that the circumstances are particularly propitious for the largest,the most cosmopolitan, the most notable gathering in 1893 that botany has ever had in this country. There will be a nnmber of distinguished foreign specialists in attendance, and the fame and benefits of the convention will not be confined within our own geographical borders.

If there is a single botanist, or any number of botanists, who has a suggestion, a word of encouragement to the committee, or any opinion regarding the project, now is the time to give it expression through the journals. Silence means apathy, but what is wanted is enthusiasm.

CURRENT LITERATURE.

Canadian Mosses.[1]

The Catalogue of Canadian Plants has now reached the mosses. The list with its annotations and descriptions of new species makes an octavo pamphlet of nearly 300 pages. Mr. Macoun has been a most industrious collector and the Herbarium of the Geological Survey will need to be consulted now by every student of our moss flora. Since 1861 he has been accumulating the material which is here elaborated. 953 species are listed, and numerous varieties, a considerably greater number than were included in 1884 in Lesquereux & James Manual for the whole of North America.

It is unfortunate that Mr. Macoun was not more cautious in the choice of bryologists to work up these rich collections. Undoubtedly he has found many new species; but no one can believe that 237[2] out of 953 are previously undescribed! Both Kindberg, who has been his chief collaborator, and Müller are looked upon by the best bryologists as too much inclined to establish species upon insufficient material and slight differences (to put the case mildly). Indeed the catalogue itself bears abundant evidence of this tendency.

A comparison of the determinations of the centuries of Canadian

[1] Macoun, John and Kindberg, N. C.—Catalogue of Canadian Plants. Part VI. – Musci. (Geological and Natural History Survey of Canada.) 8vo. pp. viii, 295. Montreal: printed for the government by W. F. Brown and Co. 1892. —25 cents.

[2] Fide Mrs. E. G. Britton in *Bull. Torr. Bot. Club.*

Musci, many of which were named by Kindberg, with the names given in this list shows gross carelessness either at one time or the other. The definitions of the alleged new species, nearly one-fourth of which are sterile, are inexcusably bad. They are so brief, unsystematic, comparative, and in such bad English that it is doubtful if the plants intended can be identified without a re-study of the nearly inaccessible types. For although Mr. Macoun states that "a duplicate of every specimen sent to Dr. Kindberg has been mounted and placed in the herbarium of this department" these cannot be considered the types, however helpful they may be.

Altogether we must conclude that what might have been a work of the greatest value to American bryologists has its good distributed through a heap of rubbish which somebody must sort over before the good can be separated from the bad. For there is much that is valuable, and the indefatigable industry of the Canadian Botanist cannot be rendered entirely nugatory by the poor judgment of his European collaborators.

Contributions from the National Herbarium.

The latest of these was issued September 20th, and forms No. 5 of the first volume. Its contents are as follows: 1. List of plants collected by Dr. Edward Palmer in 1890, on Carmen Island, by J. N. Rose. This island is in the lower part of the Gulf of California, 120 miles south of Guaymas, and, so far as known, has been botanically explored only by Dr. Palmer. The Flora is almost identical with that of the near-lying Californian peninsula. Of the 68 species known to the island, but 7 are thought to be endermic, 5 of which are described in the present paper, 3 of them being illustrated by full page plates. 2. List of plants collected by the U. S. S. Albatross, in 1887–'91, along the western coast of America, by J. N. Rose, D. C. Eaton, J. W. Eckfeldt, and A. W. Evans. This part contains six divisions: (1) List of plants from Cocos Island, by J. N. Rose. This island lies about 500 miles southwest of Panama. (2) List of plants from Galapagos Islands, by J. N. Rose. The plants of these famous islands were first collected by Darwin. (3) List of Ferns, from southern Patagonia, by D. C. Eaton. (4) List of Mosses, from Fuegia and Patagonia, by D. C. Eaton. (5) List of Liverworts from Southern Patagonia, by A. W. Evans, with two plates. (6) List of Lichens from Southern Patagonia, by J. W. Eckfeldt. 3. Revision of the North American species of Hoffmanseggia, by E. M. Fisher. The author enumerates 17 species, with full synonymy and range. The H. falcaria group is recognized in its polymorphic character, and 5 varieties of it proposed. Three new

species are described, and the whole revision gives evidence of a very painstaking work. 4. Systematic and alphabetic index of new species of North American Phanerogams and Pteridophytes, published in 1891, compiled by Josephine A. Clark. This index supplies a very great desideratum, and is properly supplied to botanists by the government. There is also in preparation an index covering preceding years back to 1885, and the promise is given hereafter of an annual index. It is startling to find that a list of the new species of North American vascular plants published in a single year occupies nearly 24 pages, but the number is very much reduced when it is noticed that all changes in nomenclature which have involved new combinations are included. The Division of Botany has put students of systematic Botany under great obligation in preparing this index and in promising its continuance.

NOTES AND NEWS.

Rev. F. D. Kelsey, of Helena, Montana, has accepted the chair of Botany at Oberlin College. He is to spend the winter and spring at Harvard University.

Dr. R. Chodat, Professor of Botany at the University of Geneva, Switzerland, desires copies of papers written by American botanists for the library of the university.

The fungous diseases of Iowa cereals are briefly treated by Prof. L. H. Pammel, especially the rusts and smuts, in a recent Bulletin (No. 18) of the Iowa Experiment Station.

Presentation exercises were held October 15th, by the botanical seminary of the University of Nebraska, when a bust of Darwin was placed in the Herbarium of the University.

Mr. J. B. Farmer, for some time past demonstrator of botany at Oxford University, has been appointed assistant professor of botany at the Royal College of Science in South Kensington, as successor to Dr. D. H. Scott, who has gone to the Jodell Laboratory at Kew.

In a handsomely printed pamphlet of 78 pages, Professor J. E. Humphrey gives a very interesting account of "Amherst Trees." The work is designed primarily for the citizens of Amherst, but it contains much valuable information for the general reader, and notes that will be of use to the professional botanist.

The causes of electrical disturbances in the plant have been investigated by Otto Haake (Flora, 1892, pp. 455–487), who finds that respiration and carbon-dioxide assimilation are chiefly concerned, while the movement of sap, as Kunkel believed (Arb. d. bot. Inst. zu Würzburg, ii, p. 1), has but little to do with it.

IN THE *Scientific American* (Sept. 3rd) is the description, by W. T. Davis, of a new hybrid oak found upon Staten Island. It is a hybrid of Q. nigra and Q. ilicifolia, and is named Q. Brittoni. It is further commented upon, and tracings of leaves given in the Proceedings of the Nat. Sci. Ass., of Staten Island, for September 10th.

THE MARRIAGE of Mr. O. F. Cook and Miss Alice Carter occurred on October 11th. Mr. Cook is well known to all students of hepatics through his distribution of Hepaticæ Americanæ in conjunction with Dr. Underwood. Miss Carter is also a botanist who has recently made contributions to botanical literature in the field of pollination and color of flowers.

A DISEASE OF POTATOES, in which the stems turn brown at the surface of the ground, and the whole plant soon dies, has been observed in France, and found by MM. Prillieux and Delacroix (Compt. rend., cxi, p. 208) to be due to a microbe, which they name Bacillus caulivorus. The disease can be transferred to geraniums, beans and lupines, but not to other plants.

M. A. FRANCHET, in *Journal de Botanique* (Sept. 16), describes the species of Lilium from China and Thibet represented in the herbarium of the Muséum de Paris. The study is especially difficult on account of the long interference of man with these showy flowers, and it becomes well nigh impossible to determine original forms. However, 24 species are described, 10 of which are new.

ACTA PETROPOLITANI (Tom. XI. fasc. ii), 1892, contains the usual amount of interesting material concerning the Asiatic flora, a flora of special interest to North American botanists. The Apetalæ of the Radden collection are presented by F. Herder; seventh to tenth decade of new Compositæ, by C. Winkler; and descriptions of many other new plants by Batalin, Korzchinsky, and E. Regel.

A REVIEW OF THE SUMMER SCHOOL movement in the University of Minnesota is given in the last *Quarterly Bulletin* of that institution. Four sessions have been held; in 1881, 1882, 1883 and 1892, with an attendance of 45, 75, 104 and 741 respectively. The botany was given by Prof. C. E. Bessey, in 1881, Prof. J. C. Arthur in 1882, and Prof. Conway McMillan in 1892. Botany was omitted in 1883.

BOTANY PARTAKES of the renaissance that characterizes the present administration at Brown University. The Freshman class numbers 140; the Woman's Adjunct, 40. Professor Bailey now has in his department 92 students in all. The president proclaims himself an "apostle of botany." In his annual report he declares the present accomodations of the department "ludicrously inadequate."

During the vacation an attempt has been made to improve, by painting the halls, the introduction of water, new cases and tables, the general outfit of the little laboratory. The room, however, is so small, that the professor is compelled to take the larger class sections into other buildings. There is a good outfit of microscopes and re-agents. Mr. W. T. V. Osterhout, of the Senior class, has spent the summer in study at Wood's Holl, and acts as demonstrator in the advanced classes. A new building to accommodate the lecture rooms, laboratory and herbarium is a crying necessity.

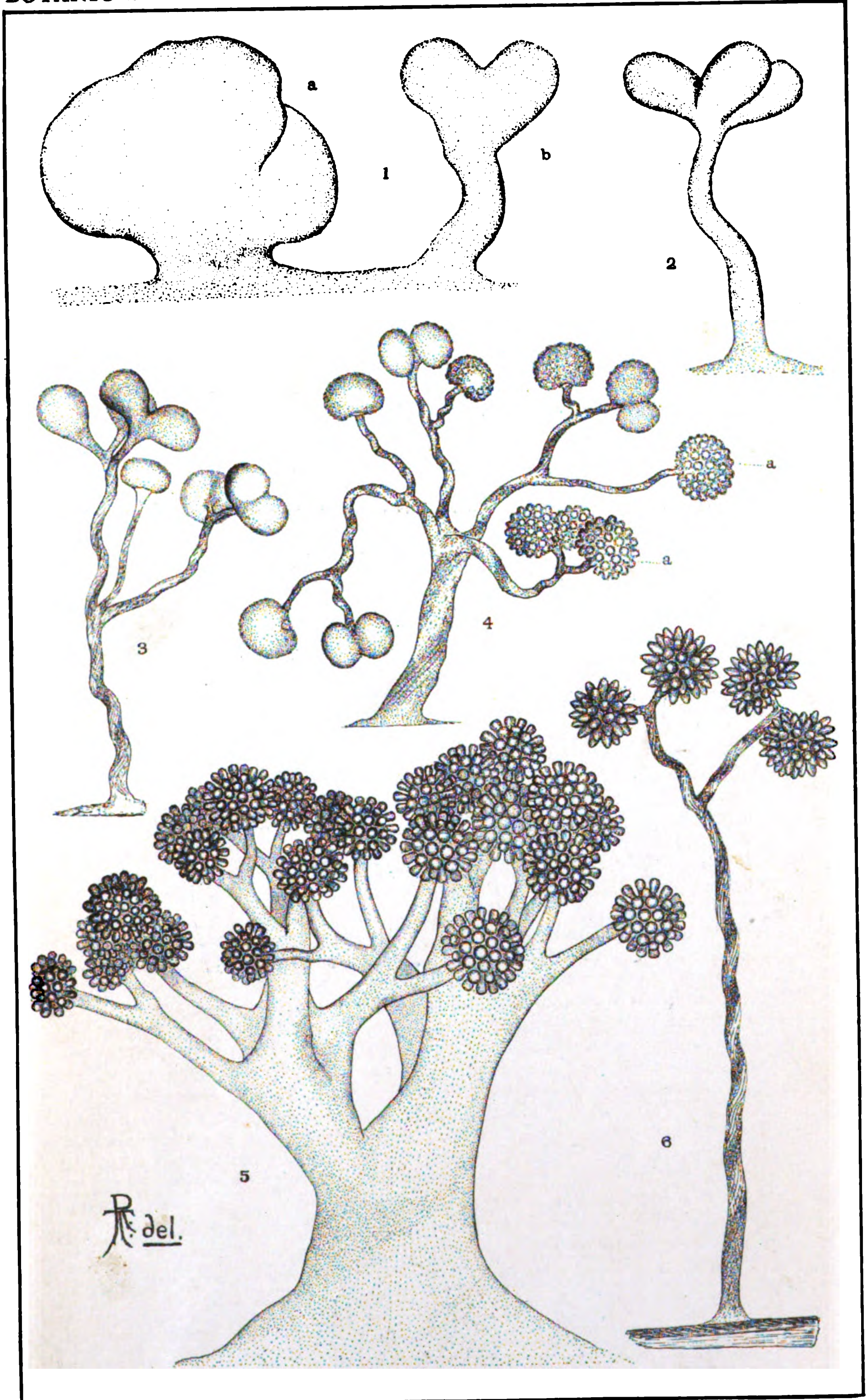
The morphology of the flower of Anthoxanthum has been studied by Mr. Theo. Holm in malformed flowers found in the Smithsonian park, at Washington, D. C. The subject forms an illustrated article in the Proceedings of the National Museum (xv, p. 399), in which the conclusion is reached "that the two awned glumes inside the proper empty ones really belong to two neutral flowers, and that the perfect flower has both a flowering glume and a palet, thereby not being terminal but lateral."

The *Journal of Botany* for October contains the description of a new Ranunculus from W. Scotland, allied apparently to R. Flammula. Mr. Baker's Synopsis of Malveæ continues with species of Sida, this number containing 6 new species. The Rev. W. Moyle Rogers also continues his "Essay at a Key to British Rubi", which if successful will be a great relief to British botanists. Mr. George Massee also pays his respects in a sprightly fashion to Mr. G. Romanes, in a review of his "Darwin and after Darwin."

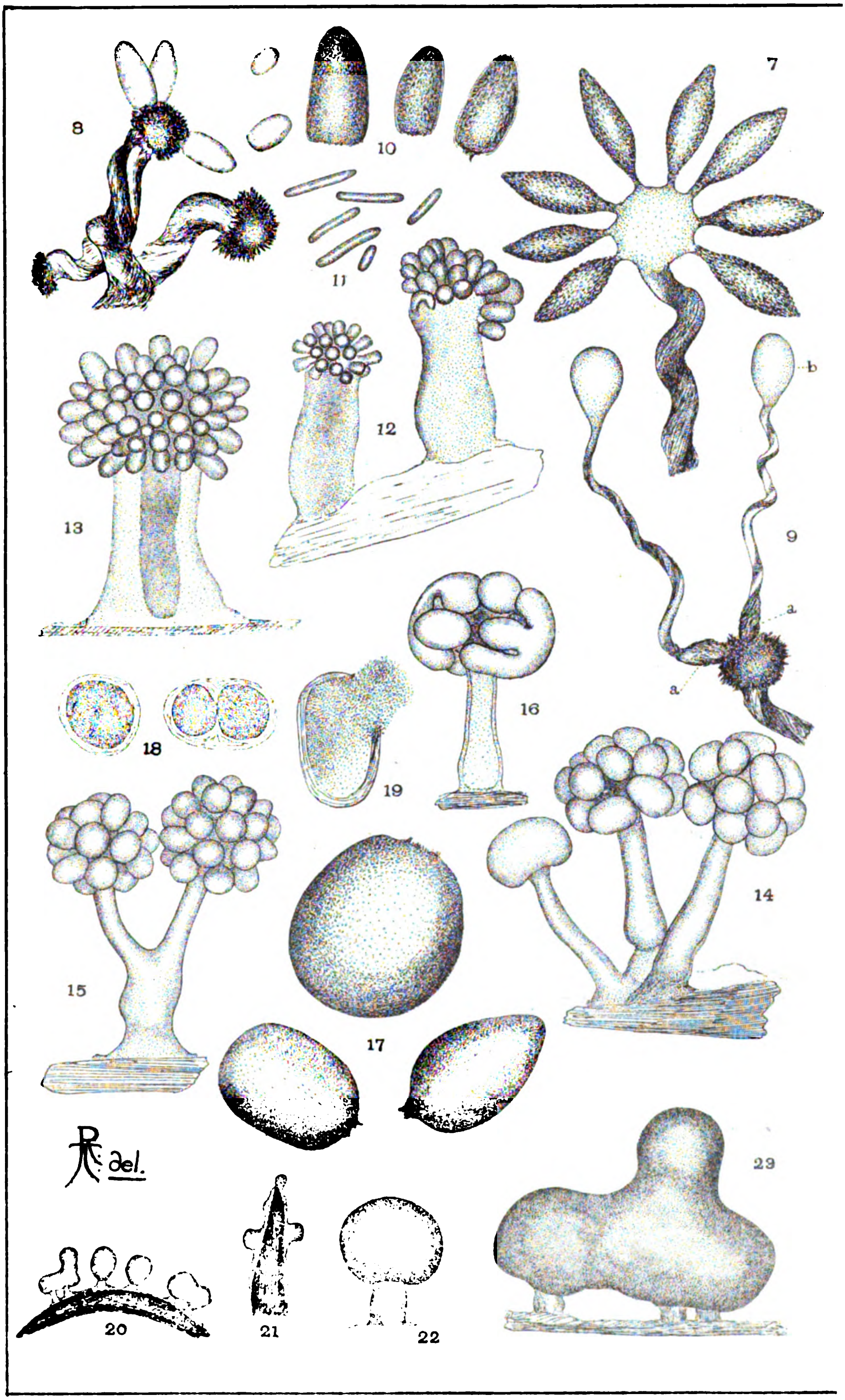
The volume of proceedings of the American Association for the Advancement of Science, for the year 1891, has recently been distributed. Besides the presidential and vice-presidential addresses of Prof. Geo. L. Goodale and Prof. John M. Coulter, which are printed in full, there are eighteen botanical papers, all but two in the form of very brief abstracts, often consisting of only a few lines. The papers by Professors Bessey and Beal, on transpiration and movement of water in plants, cover four pages each.

The second report upon electro-horticulture (Cornell Univ. Bull., No. 42), by Prof. L. H. Bailey, firmly establishes the commercial value of the electric light for certain winter crops, especially for lettuce. Certain kinds of plants, which are injured by the direct rays of the light, are not injured, and may even be benefited, when the light passes through a clear glass globe, or through a glass roof. Auxanometric records appear to show that the light accelerates growth, but does not change its normal periodicity.

In the *Annals of Botany* (July, 1892) J. Bretland Farmer calls attention to a remarkable abnormality in the development of the ovule of *Pinus sylvestris*. He has discovered two distinct endosperms or prothallia in the ovule. The prothallia are separated by a well-marked wall which runs obliquely between them, and is continuous with the wall of the cavity containing them. Both prothallia have pefectly developed archegonia. This clearly indicates that two macrospores have been developed instead of one. Mr. Farmer suggests that this might have arisen by each of the two cells into which the embryo-sac-mother-cell divides, developing into a prothallium, where normally only the lower so develops. Or, as in certain other Coniferæ (as Thuja) in which several mother cells are differentiated, but only one macrospore normally reaches maturity, two independent mother cells may possibly have developed into prothallia.



THAXTER ON SCHIZOMYCETES.



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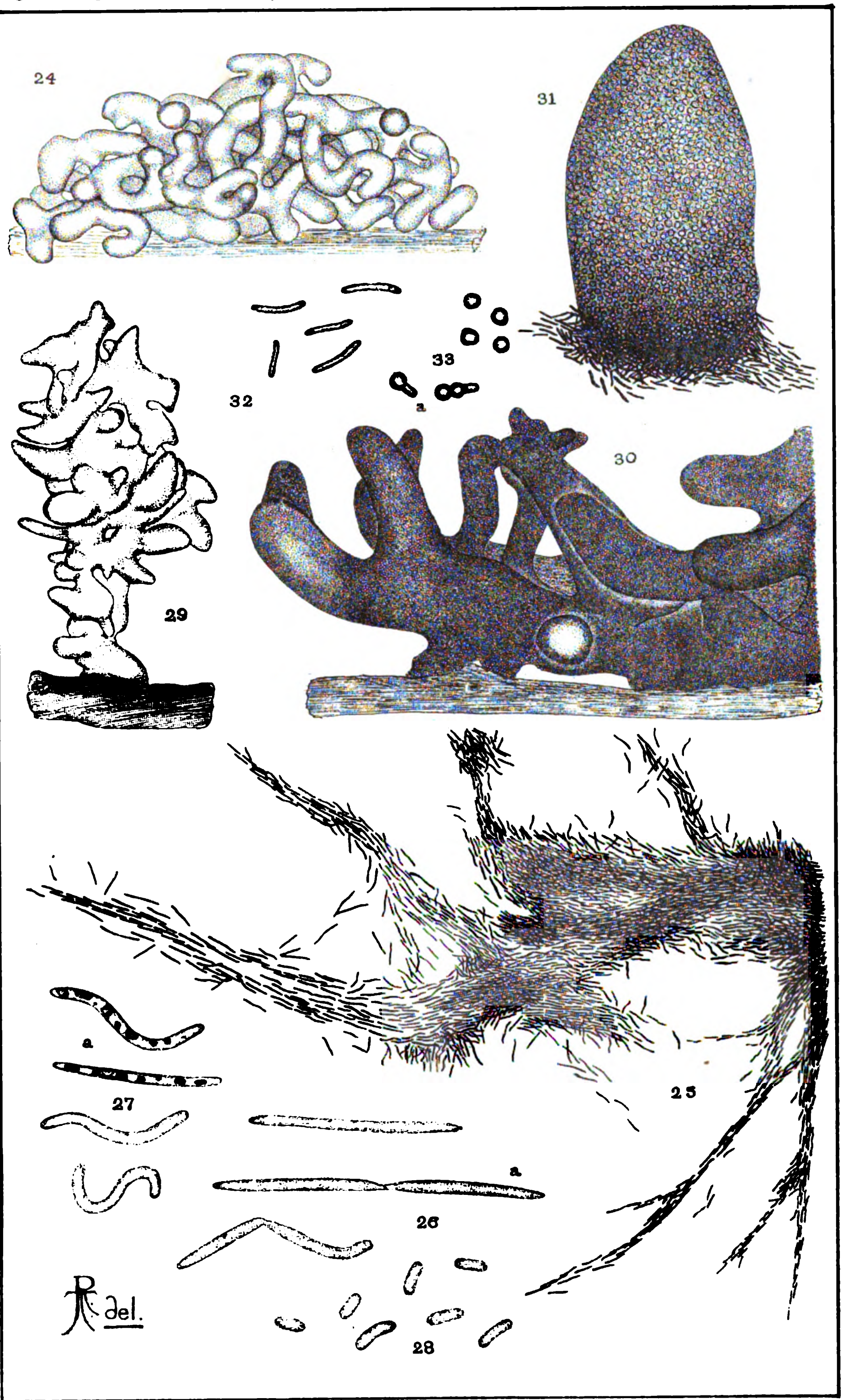

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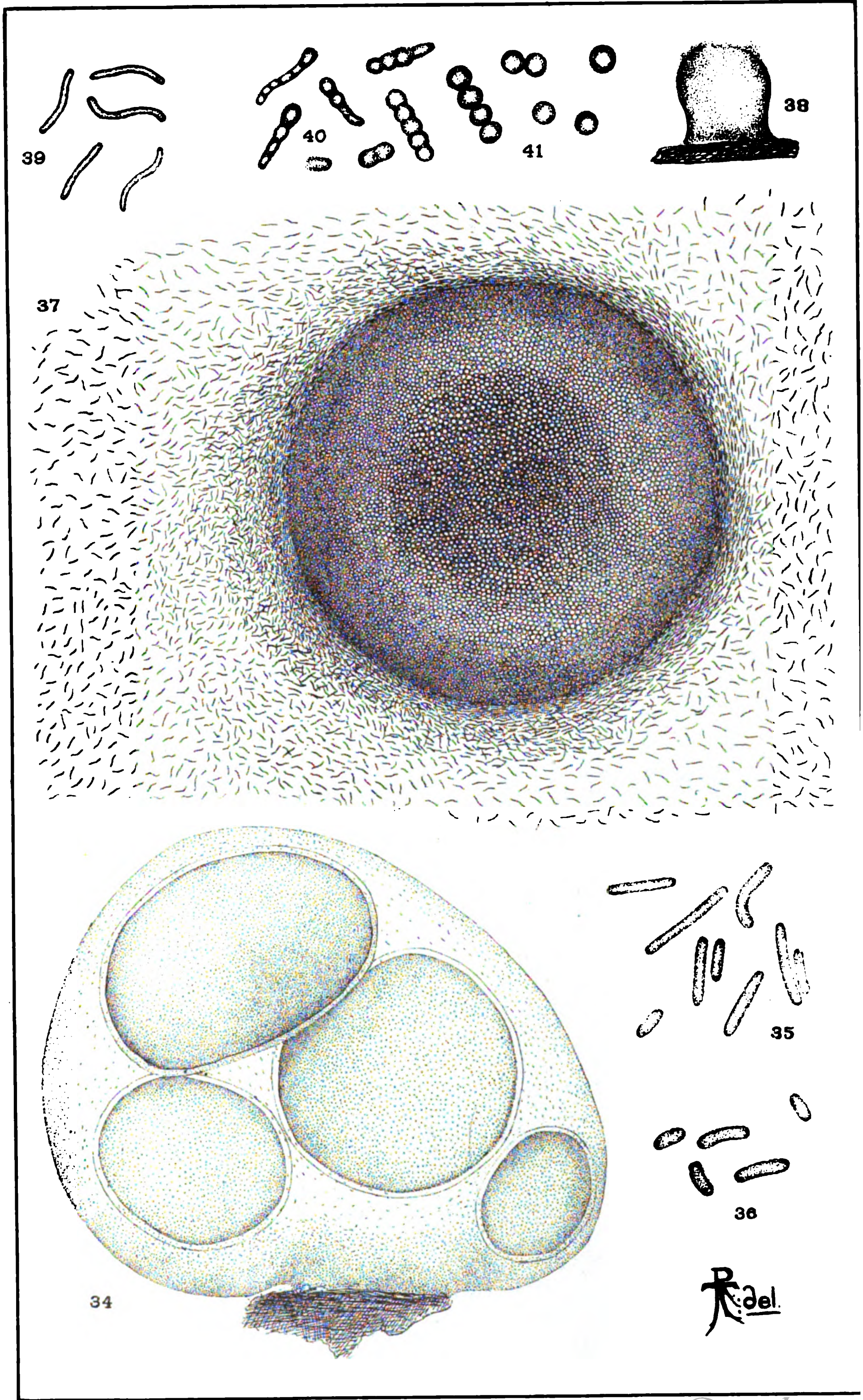


THAXTER ON SCHIZOMYCETES.

BOTANICAL GAZETTE

DECEMBER, 1892.

Contributions from the Cryptogamic Laboratory of Harvard University. XVIII.

On the Myxobacteriaceæ, a new order of Schizomycetes.

ROLAND THAXTER.

(WITH PLATES XXII–XXV.)

A few years since, while collecting fungi at Kittery and in several other localities in New England and the southern states, the writer's attention was attracted by a bright orange-colored growth occurring upon decaying wood, fungi and similar substances, which, although in gross appearance it seemed somewhat highly organized, was found, when examined in a presumably mature condition, to consist of apparently amorphous material, without signs of hyphæ or spores of any kind. Its general appearance and the character of the substance which composed it suggested an immature condition of some myxomycete which had become dried while in the act of rising from the substratum to form its fructification, and on this supposition the material was laid aside until attention was again drawn to it by the occurrence on tree lichens in New Haven, of a closely related organism, which, when artificially cultivated, yielded immature conditions that rendered its true nature apparent. In addition to the two forms just mentioned, the writer has, during the past year, been fortunate in obtaining and cultivating several others having a similar life history, and it is upon these observations that the present paper is based.

This life history, which in several cases has been ascertained by the direct observation of pure cultures made upon sterilized media, is so peculiar, and corresponds so closely, despite the considerable differences which distinguish the more simple from the more highly differentiated forms, and is altogether so unique in the group of Schizomycetes, to which they should undoubtedly be referred, that their separ-

ation as a distinct order seems unavoidable. To the members of this order the writer proposes to give the name MYXOBACTERIACEÆ, for reasons which will become apparent if we consider for a moment the more important stages in their development.

It should first be noted that the life history of these organisms shows a distinct and more or less regular division into two periods; a period of vegetation and, under favorable conditions, a period of fructification or pseudo-fructification: but while the first period is essentially similar in all the forms observed, the second presents remarkable variations.

In the first instance a swarm or collection of rod-like bodies, derived from the successive division by fission of one or more primary individuals, always distinct from one another, possessing a power of slow locomotion and secreting as they multiply a firm gelatinous base which connects the colony as a whole, constitutes the vegetative condition of the organism. This vegetative state continues for a variable but distinct period of time, and in the different forms is characterized by slight variations in the grouping of the individuals composing it. In some cases these may be collected in radiating strands or concentric ridges, or again may be distributed evenly throughout the colony, which in all cases, when growing on a solid medium, possesses a clearly defined advancing edge or border, produced by a heaping up of active individuals in this position. The colony continues to extend itself in this fashion while the conditions remain favorable for its growth; but in the meantime the individuals within this advancing border, having increased rapidly by fission for a certain period, begin to swarm together at different points, often with a characteristic circular tendency in their motion. This piling up of individuals at definite points marks the beginning of the second period just mentioned, which has for its object the production of a resting state.

In the simpler forms, these masses, having raised themselves above the substratum in the form of papillate projections, become rounded off and may be directly encysted without further differentiation. A gelatinous envelope becomes hardened about them to form a protecting wall, within which the encysted individuals are capable of withstanding unfavorable conditions for a protracted period.

From such a simple type as that just described the forms

examined show various degrees of complexity, which reaches its maximum in a most remarkable organism, apparently identical with the supposed fungus described by Berkeley and Curtis under the name of *Chondromyces crocatus*. In this instance we have, following a period of purely vegetative activity, the same swarming together of individuals at different points in the colony; but the masses thus formed, instead of rounding themselves and becoming directly encysted, as in the previous instance, continue to rise vertically from the substratum into the air. The base of the rising mass becomes constricted; the constricted portion is gradually modified into a slender supporting stalk, formed partly of individuals left behind and partly from a gelatinous substance secreted by the mass as it rises. We have then a mass of individuals rising vertically on a slender stalk secreted from its base. This stalk may remain quite simple, or through the division of the mass into two or more lobes, may become successively several times branched, each lobe rising as a distinct mass on a secondary stalk of its own. Finally a condition is reached in which the stem or cystophore, as it may be conveniently called, is terminated by one or more rounded masses of very similar dimensions, in number corresponding to the ultimate divisions of the cystophore, and from these masses arise the cysts which perform the function of reproductive bodies. The cysts first appear as papillate projections covering the surface of each ultimate mass (fig. 4, *a*). The papillæ then become constricted at the base, as the rods composing the mass migrate into them, and assuming at first a fusiform-shape, are finally converted in subconical cysts of very regular size and form. The cysts are caducous at maturity, falling from their attachment at the slightest touch, and are disseminated through the air like the conidia of many fungi, which they closely resemble. After a period of rest, and under favorable conditions, the rods make their exit simultaneously from the cyst, leaving behind an empty shell and enter at once upon a new vegetative period; or sometimes, while still *in situ*, proceed to form a secondary cyst (fig. 9, *b*).

Such are the extreme variations in the group, so far as concerns the differentiation of the cyst-producing generation. There appear to be, however, other important differences which divide the forms rather sharply in connection with the

modification of the individual rods at the period of encystment. For while in one group (Myxococcus), they become transformed into definite spores, in the other (Chondromyces and Myxobacter), the rods are encysted as such with little apparent modification, as far as the writer has been able to ascertain.

Without entering into further details of structure or development, which will be found below, sufficient has been said to make intelligible a brief comparison between the course of development of these plants and that of other organisms which may seem to possess certain characteristics in common with them.

The general character and structure of the rod-like individuals, together with their vegetative multiplication by fission, renders their schizomycetous nature as individuals a matter hardly to be doubted: but, on the other hand, the question may fairly be asked whether the remarkable phenomena which they present, not as individuals, but as aggregates, may not indicate a possible relationship in other directions. In the account just given it is hardly necessary to point out the evident similarity between the course of development described and that which occurs in the Mycetozoa, and more particularly in the Acrasieæ. In no other group, as far as the writer is aware, does there exist a similar concerted action of aggregates of individuals towards a definite end, namely, the production of a more or less highly differentiated resting state. Setting aside for the moment the fundamental differences presented by the cell characters in either group, the vegetative condition of the Acrasieæ and that of the Myxobacteriaceæ may be considered strictly comparable. In both cases multiplication by bipartition, followed by the complete separation as individuals of the two parts thus formed is followed in turn, after a period of successive bipartitions, by a swarming together of distinct individuals into aggregates of distinct individuals having a definite end in view. Apart from differences of cell structure, therefore, the essential characters of a pseudo-plasmodium are common to both groups.

Following the analogy to later stages of development a certain similarity may be noted between the steps which lead in either case from the simpler to the more complicated forms. In both instances a transition is observable from a mere heap-

ing together of individuals to form a resting state, to the production of a similar state, developed in a more complicated fashion and raised upon a highly differentiated stalk, through intervening forms, in which this stalk appears merely as a supporting base.

The most essential discrepancy which is apparent in such a comparison rests on the fundamental difference in cell structure already referred to, since although the Acrasieæ have taken a decided step away from the true Myxomycetes in the production of cells which neither coalesce nor produce pseudopodia (as in the Guttulinaceæ), the step from such amœboid cells to definite rods having all the characteristics of typical schizomycetous cells is, to say the least, a very long one. This fundamental difference necessarily involves equally important differences connected with the modification of individuals, in either case, while in the resting state, even when a definite spore formation takes place in both instances; while the encystment of numerous individuals to form a spore-like body, in the manner above described, presents an additional point of deviation in this connection.

In view of such important differences, the writer would hesitate to assume even a remote genetic connection between the two groups on a basis of resemblance which might well be purely accidental. Yet it is a question to which further investigation in this direction may afford a more definite answer, whether the evidence at hand may not show the necessity of still greater caution in accepting the views of those who would unceremoniously relegate the Mycetozoa to the domain of pure zoology: since, other matters apart, we find in the present order a characteristic at least very similar to that which has been held to constitute a crucial difference between the Mycetozoa and any known group of *plants*, namely, the occurrence in their developmental history of phenomena closely resembling those presented by plasmodia or pseudoplasmodia—not an indiscriminate heaping together of individuals as a result of merely vegetative processes, but a definitely recurring aggregation of individuals capable of concerted action towards a definite end, an end which finds its accomplishment in the production of a more or less highly developed resting state.

Whatever its true affinities may prove to be, however, the order is undeniably a very interesting and important one,

and although the present account is necessarily incomplete, it may serve to call attention to a subject which, beyond question, offers a productive field for further investigation.

Historically the story of the group is not a long one, yet is instructive in showing the absurdities to which the careless and wholesale description of new species may lead. *Chondromyces aurantiacus*, for example, has, if the writer's conclusions are correct, been placed in three separate genera of hyphomycetous fungi, although possessing no trace of hyphæ or of spores, the slight striation of the shrunken cystophore in the one case and the general external appearance of the cysts or of their contents in the other, having been made to assume these functions for descriptive purposes. The same is also true to a less degree of *C. crocatus*, although from its apparent rarity it seems to have escaped an extended synonymy. Whether any of the other forms enumerated below have been previously described the writer is unable to say; yet it seems very improbable that the spores of such common and conspicuous forms as *Myxococcus rubescens* and *M. virescens* should have escaped description, at least as chromogenous micrococci. The species of *Cystobacter* Schröter seem with little doubt to belong to the present family, and should probably be referred to *Chondromyces*, possibly *C. aurantiacus*, which in artificial cultivation produces a variety of abnormal forms and becomes "kastanien braun" when kept moist for a certain period. The descriptions of Schröter, however, are not sufficient to render any definite conclusion possible in the absence of proper figures.

MYXOBACTERIACEÆ.

Motile, rod-like organisms, multiplying by fission, secreting a gelatinous base, and forming pseudoplasmodium-like aggregations before passing into a more or less highly developed cyst-producing resting state, in which the rods may become encysted in groups without modification or may be converted into spore masses.

General Characters.—The vegative rods present but slight variations in size and form in the different genera and species. In all cases they are typically elongate, sometimes attaining a length of 15μ and, while living, show a tendency to taper slightly towards either extremity which disappears when they are killed, the ends becoming

bluntly rounded. The cell wall is highly elastic and surrounded by a barely perceptible gelatinous layer, while the cell contents may usually be seen to contain distinct granular masses (fig. 27, *a*) of irregular size and shape which stain more deeply than the remainder of the cell. Cell division follows an elongation and nearly median constriction of the rods which, except at the moment of division, are always separate, never united in chains. A slow, though distinctly visible movement characterizes the active rods and consists in a sliding locomotion in conjunction with a lateral bending. This lateral movement, which may take place in any plane, may be carried to such an extreme that the rod may form a loop with its ends approximated, after which the normal straight position may be assumed with considerable rapidity. This bending movement is doubtless an important factor in the sliding locomotion which though barely perceptible, can be definitely ascertained by careful watching.

The grouping of rods in a colony may vary somewhat in different species and under different conditions. In *Chondromyces aurantiacus*, for example, they may, when growing in a semi-liquid medium, show a tendency to radiate from a common center in rope-like, anastomosing strands, while on a solid medium these strands may form ridges, the alternate elevations and depressions in which may give the colony a characteristic corrugated appearance. In other cases, as for example in Myxococcus, the rods may show less tendency to collect together, remaining more or less evenly distributed until just before the period of spore formation. In all cases the individuals of a colony are heaped together in the region of its advancing margin which is distinctly elevated above its surroundings, and characteristically roughened by great numbers of partly free individuals projecting from its surface. In all species, with one exception, the rods when seen in masses, are more or less distinctly reddish. This color may, however, be lost as the mass rises to form cysts, as is the case in *C. crocatus* as well as in *Myxobacter aureus*.

A distinct, firm, hyaline, gelatinous base is secreted by the colony as it extends itself, over which the individuals may move or in which they may become imbedded, and is so coherent a structure that whole colonies may be stripped intact by means of it, from the surface of nutrient agar, for example. At the period of cyst formation it is often left

behind as a distinct shining membrane in which a few rods remain here and there imbedded.

The duration of the vegetative period varies according to circumstances. In artificial cultures it usually lasts about a week or even two weeks; but in nature the production of cysts must certainly be more rapid. In *Chondromyces lichenicolus*, for example, a period of moist weather following continued drought, and lasting not more than two or three days is sufficient to cover the previously dry tree trunks on which it vegetates with large patches of cysts.

The preparations for the production of cysts are apparent to the naked eye in artificial cultures of *C. crocatus*, for example, about a day before the cystophores begin to rise. In this condition the colony even in the neighborhood of its advancing edge, assumes a lumpy appearance owing to the aggregation of rods at various points. In forms like Myxococcus, in which the rods are somewhat scattered, the first preparation for spore production as seen under the microscope consists in the appearance of groups of rods moving with a circular tendency and forming whirlpools, so to speak, in which the more central individuals soon become converted into spores, the successive formation of which results in the production of the elevated spore masses characteristic of the various forms.

The formation of a cystophore where it occurs results from the basal constriction of a papillate mass of rods which projects from the surface of the colony. The mass of rods moving upwards on one another, continually leaves behind and below it an external layer at its base which has become slightly hardened by exposure to the air and is composed partly of the gelatinous matrix, partly of individuals which soon become indistinguishable in it. As the mass rises within and above this slightly hardened layer, the latter, while being constantly renewed above, becomes contracted below to form the cystophore. The cystophore may therefore be compared during its formation, to a glass funnel, the flaring portion of which is being constantly renewed from the outer surface of the mass of rods contained within and rising above it, while the tubular portion is being constantly lengthened by the contraction of the flaring portion at its base. As the freely moving individuals pass up out of the upper portion of this tube it is left behind as a gelatinous structure which becomes

indurated and solid, its strength being often further increased in slender forms by a decided spiral twist.

This primarily tubular character of the cystophore is well shown in specimens of *C. aurantiacus* when cultivated with very moist surroundings. In such cases even after the cystophore has attained its full height a central clearly differentiated column of active individuals may be seen moving up to the cysts which are in process of formation at its summit (fig. 13). In its development the cystophore shows all degrees of complexity from the short supporting base (which may be wholly absent) of *C. lichenicolus*, to the elongate form in *C. crocatus* which may produce branches of the fifth or even sixth order.

In considering the encysted condition of these organisms, two distinct categories are recognizable in connection with this state, one in which the individuals thus encysted show little or no modification from the rod-like vegetative state, the other in which they are converted into definite spores.

In the first instance the form of the cyst varies considerably presenting in the genus Chondromyces the series illustrated by *C. serpens*, *C. lichenicolus*, *C. aurantiacus* and *C. crocatus* (figs. 24, 23, 22, 15, 14 and 6) and may be further modified by a more or less complete fusion of adjacent cysts originally distinct (figs. 24, 23, 16). This fusion may result in the anastomosing coil characteristic of *C. serpens* or may consist in a mere lateral adherence of two neighboring cysts as in *C. crocatus*. The degree of encystment also shows considerable variation in the series just mentioned and reaches its highest development in *C. crocatus* in which the distinction between cyst wall and cyst contents is clearly marked. The cysts of Myxobacter present an additional peculiarity in that the very large thick walled cysts are themselves involved in a gelatinous matrix which dries in the form of a tough general envelope.

The substance of these cysts, composed partly of rods and partly of a firm and surprisingly coherent matrix, appears at maturity even when examined under a high power of the microscope, to be composed of stringy amorphous matter which is separated by crushing with the greatest difficulty. It is only by the closest examination and the use of staining agents that the presence of any definite bodies whatever within such cysts can be made out. Here and there the closely adhering

rods may be separated and isolated by crushing; and in this condition they show little modification from the vegetative state except that they are somewhat shorter and thicker. In a few cases rods have been observed within the cysts in stained preparations in which an apparent differentiation of the rod contents was observable. Whether this appearance was due to the presence of spores or merely indicated an accidental aggregation of the granular cell contents was not determined.

For a short time after the cysts are mature and also before they germinate after a period of rest, the contained rods are clearly defined and do not adhere closely to one another. The contents of such a cyst when crushed makes its exit as a mass of distinct rods somewhat shorter and thicker than the vegetative forms.

In "germination" the cysts emit their contents in a continuous stream which finally leaves the cyst wall as an empty shell, the emission being effected through the absorption of a portion of the cyst wall, usually at the base in the spore-like forms, sometimes at the apex or elsewhere. The mass of rods thus freed begins at once to vegetate, the individuals dividing rapidly and entering upon a new period of activity. Exceptions to this course are often found in old cultures of *C. crocatus* where cysts that have germinated *in situ* at the tips of the cystophores may frequently be seen producing secondary cysts directly, which are borne on short, slender secondary cystophores (fig. 9), a circumstance which still further illustrates the remarkable though superficial resemblances which exist between these forms and higher fungi.

In the sporiferous species, which have been included in the single genus Myxococcus, there may be a general encystment of the spore mass into a definitely formed coherent structure, as in *M. coralloides*, or this structure may normally become soft and semi-fluid through the deliquescence of the gelatinous matrix in which the spores are imbedded, as in *M. rubescens* and *M. virescens*. The spores are more or less irregularly spherical refractive bodies, the diameter of which is much greater than that of the rods from which they are derived, the difference being most remarkable in *M. rubescens* and *M. virescens*. The method by which the spores are derived from these rods has not been ascertained by continuous observation, since sporulation only takes place at the period when

the rods swarm together for this purpose and then only in the central region below the rising mass of spores which, together with the aggregation of rods around it, completely conceals the details of transformation when viewed directly under the microscope. By crushing such masses, however, the steps by which the spore-production is effected may be inferred from the occurrence, here and there in the swarm of unmodified rods and spores thus separated, of forms similar to those represented in fig. 40. Such forms would indicate that the rod, by division following simultaneous or successive enlargement throughout its whole length, is directly converted into spores varying in number according to the length of the rod; and in the absence of any indication of a different process this may be assumed to be correct. This conclusion is further supported by the very frequent occurrence in such preparations of chains of spores adhering in twos, threes or even fives (fig. 41).

The germination of these spores has not been observed to the writer's satisfaction; but appears to consist in a gradual transformation from the round to the rod-like form. Whether an external membrane is left behind in this process could not be determined.

The nine species which constitute the family so far as at present known, may be arranged under three genera, as follows:[1]

CHONDROMYCES B. & C. (1857), in Berk. Introd. Crypt. Bot., p. 313, fig. 70, a (no descr.) 1857. do. in Grevillea III. p. 64 (first descr.) 1874.

Stigmatella: B. & C. in Berk. Introd. Crypt. Bot., p. 313, fig. 70, b (no descr.) 1857. do. in Grevillea III, p. 97 (first descr.)
? *Polycephalum:* Kalch. & Cke. in Grevillea IX, p. 22, 1880.
? *Cystobacter:* Schroeter in Kryptogamen-fl. v. Schlesien III, I, p. 170.

[1] NOTE.—In considering these forms from a systematic point of view the writer has preferred to avoid the multiplication of genera and species; since the true value of generic and specific distinctions in a group so little known in these respects, is a matter which can only be settled satisfactorily by a wider knowledge of the remaining forms, which undoubtedly exist. For this reason it has not been thought advisable to separate generically members of the series included under Chondromyces, the connection between the extreme forms (*C. crocatus* and *C. serpens*) being so well illustrated by the remaining species. Again, the deliquescent guttulae which constitute the spore masses of *Myxococcus rubescens* and *M. virescens* and the definitely coherent structure found in *M. coralloides* are very different in character, yet in the absence of further data as to species a generic discrimination of these forms seems inadvisable. The writer recognizes the fact, however, that further information may modify the arrangement adopted not only in regard to genera and species, but also in connection with the division of the groups as a whole, which might properly be divided into two definite sub-families based upon the peculiarities of the resting condition.

Rods forming free cysts, in which they remain unmodified. Cysts various, sessile or borne on a more or less highly developed cystophore.

CHONDROMYCES CROCATUS B. & C. Plates XXII, XXIII, figs. 1–11.

Chondromyces crocatus: B. & C. in Berk. Introd. Crypt. Bot. p. 313, fig. 70, a (no descr.) Berkeley in Grevillea, III, p. 64 (descr.) Cooke in Bull. Buff. Soc. Nat. Sci. III, p. 192. Saccardo, Sylloge Fungorum IV, p. 576.

Aspergillus crocatus: B. & C. in herb. Curtis, and herb. Berkeley (*sec.* Farlow).

Colonies pale orange red. Rods cylindrical or tapering slightly straight or slightly curved, $2.5–6 \times .6–.7\mu$. Cystophore orange colored, slender, simple or 1–5 times successively branched, striate, spirally twisted or irregularly bent; average height 600μ, rarely 1 mm. Cysts pale straw colored, at first fusiform, at maturity sub-conical, rounded at the apex, often ragged at the base. Average dimensions $28 \times 12\mu$ ($15–45 \times 6–20\mu$), in variable numbers at the tips of the cystophore where they form globose heads, $70–90\mu$ in diameter.

South Carolina, *Ravenel*, in herb. Curtis and herb. Berkeley, on decaying melon rind. Cambridge Mass., on old straw.

The specimens of this plant in the Curtis collection correspond in all respects with the Cambridge material which made its appearance on some old straw sent from Ceylon, and has been kept in cultivation in the laboratory, growing readily on nutrient agar and luxuriantly on sterilized horse dung. According as the substratum is moist or dry the general habit may vary considerably, excessive moisture often producing considerable irregularity in the form and number of the cysts as well as in the cystophore, which is thicker under these conditions, more irregularly branched and without the spiral or longitudinal striations (due to wrinkles of the surface) usually characteristic of the slender forms.

Cultures of the cysts in Van Tieghem cells have yielded few germinations after several months, but it may be readily observed by placing in a moist chamber a specimen which has been kept dry. By examining such a specimen after one or two days the germinating cysts may be seen in all conditions. At first the contents becomes slightly contracted within the cyst-wall and in it the separate rods may be distinctly seen; then through the absorption of the wall usually at its base, the rods are allowed to make their escape in a continuous stream till nothing but the empty cyst-wall is left behind.

The mature cysts show none of the reddish coloring pecu-

liar to the other species, and as in *Myxobacter aureus* this seems to be lost as the rod-masses rise to produce cysts. Although so conspicuous a form, this species does not appear to have been recorded since its discovery by Ravenel, Cooke and Saccardo merely quoting Berkeley's publication in the references above cited. As a matter of curiosity Berkeley's description is appended.

"*Chondromyces* B. & C. Stipes e floccis compactus ramosus induratus, sporæ apicales.—600. *Chondromyces crocatus* B. & C. On decayed melons. Car. Inf. no. 1335. Stem closely compacted, orange, subcartilaginous, branched, the branches more or less divaricate, nodular at the apex; spores elongate-ovate with a very short pedicel." Grev., *l. c.*

CHONDROMYCES AURANTIACUS (B. & C.)—Plates XXIII, XXIV, figs. 12–19 and 25–28.

Stigmatella aurantiaca: B. & C., in Berk. Intr. Crypt. Bot., p. 313, fig. 70, b. do. Grevillea, vol. III, p. 97. Cooke, Bull. Buff. Soc. Nat. Sci., vol. III, p. 193. Curtis' Cat., p. 126. Saccardo Sylloge Fung., IV, p. 680.

? *Polycephalum aurantiacum:* Kalchbr. & Cke. Grevillea IX, p. 23, pl. 135, fig. 10, a, b, c. (1880). Saccardo Sylloge Fung. IV, p. 576.

? *Stilbum rhytidospora:* Berk. & Broome, on the Fungi of Ceylon, Jour. Linn. Soc. (Botany) XIV, p. 96, plate IV, fig. 16 (1873). Sacc. Sylloge IV, p. 571.

Colonies flesh colored, distinctly reddish. Rods large, tapering somewhat, normally straight, rounded at either extremity $7–15 \times .6–1\mu$, average $7 \times .5\mu$. Cystophore hyaline or flesh-colored, stout, straight, simple or rarely furcate. Average height 200μ. Cysts at first stalked, then sessile, oval to elliptical or rounded in outline, often irregular in size and shape, bright orange colored when dry, becoming chestnut brown when kept moist for a considerable period, borne in variable numbers and forming globose heads at the extremity of the cystophore. Cysts about $30–50 \times 30–75\mu$.

S. Carolina, on *Sphæria Hibisci* (herb. Curtis). N. Carolina, Connecticut to Maine, on decaying wood and fungi.

With the exception of *Myxococcus rubescens* this is the commonest member of the group and must have been met with by any one who has sought for Myxomycetes on decaying wood, where though very minute it is conspicuous from its bright color. Although easily cultivated on nutrient agar, unlike *C. crocatus* it rarely produces well formed cystophores and cysts on this medium, though cultivable on its ordinary substrata without difficulty.

In giving its synonymy, *Polycephalum aurantiacum* K. & Ck. as well as *Stilbum rhytidospora* B. & Br. have been included

with a query. The description and figures given in either case leave little doubt of the correctness of this reference, but a comparison of authentic specimens has not been made. Whether one or both of the forms described by Schroeter under Cystobacter may not prove abnormal conditions of this species is also uncertain; but on very moist media it shows conditions closely resembling his descriptions, and becomes chestnut brown after continued exposure to moisture, thus presenting an additional point of resemblance. Even in its natural substratum cyst formation is subject to great irregularities, especially if the rising rod masses become slightly dry during the process. In such cases the latter may heap themselves together in irregular cyst masses lying directly upon the substratum with little or no differentiation of a cystophore.

The genus Stigmatella, which was founded upon this species, is made by Saccardo to include two species, *S. aurantiaca* and *S. pubescens* Sacc. & Ell., the latter having been formerly described under the name *Sphærocreas pubescens* Sacc. & Ell. (Michelia II, p. 582.) Although Saccardo remarks concerning this form, "De identitate *Sphærocreatis* cum *Stigmatella* nullum mihi est dubium," it is difficult to see on what this opinion is based; the fungus in question consisting of a rounded mass of large chlamydospores borne terminally on well defined hyphæ and surrounded by a woolly mass of somewhat differentiated hyphæ. It is needless to remark that the two can have no connection, Sphærocreas being clearly a fungus allied to if not generically identical with forms included in the genus *Endogone.*

Chondromyces lichenicolus n. sp.—Plate XXIII, figs. 20–23.—Colonies reddish, rods cylindrical, tapering slightly, $5–7 \times .6\mu$. Cystophore simple, short, squarish, often absent or ill developed, $7–8 \times 10\mu$. Cysts single, rounded or irregularly lobed, often confluent, bright red, $35 \times 28\mu$.

Parasitic on living lichens, which it destroys, New Haven, Ct.

This species has not been met with in any locality other than the one mentioned, where it occurs abundantly on the trunks of the elms and maples along the city avenues, often covering patches several feet in length. The cysts are very irregular in form, often lobulated and laterally confluent, and their crowded habit and deep red color make them very conspicuous. Owing to the shortness of the cystophore, it is seen

with difficulty *in situ*, and seems often to be wholly absent. Specimens kept dry in the herbarium for eighteen months germinate readily when sown on moist lichens, and like other cysts of the group would probably retain their vitality for a much longer period.

Chondromyces serpens n. sp.—Plate XXIV, fig. 24.—Rods as in *C. lichenicolus*. Cysts flesh-colored, dark red when dry, 50μ in diameter, confluent in an anastomosing coil. Cystophore absent.

On decaying lichens, Cambridge, Mass.

This species made its appearance in company with *C. lichenicolus* in a laboratory culture and was at first taken for an abnormal condition of that species. Cultures on agar and on lichens, however, constantly produced the same convoluted form which seems to be quite distinct and differs from all the remaining species of the genus in possessing no cystophore, the mass being sessile upon its substratum, and often reaching a length of more than a millimeter.

MYXOBACTER n. gen.—Rods forming large rounded cysts, one or more free within a gelatinous matrix raised above the substratum.

Myxobacter aureus n. sp.—Plate XXV, figs. 34–36.—Colonies when rising to form cysts milky white. Rods large, cylindrical, rounded at either end, $4-7 \times .7-.9\mu$. Cysts spherical or oblong, golden yellow, thick walled, one to twelve or more in number, distinct within a hyaline matrix, $75-350 \times 75-275\mu$. The encysted rods mingled with a yellow, oily material. Cyst groups .7—1 mm. long.

On very wet wood and bark in swamps. Kittery Point, Me., Belmont, Mass.

MYXOCOCCUS n. gen.—Rods slender, curved, swarming together after a vegetative period to form definite, more or less encysted sessile masses of coccus-like spores.

Myxococcus rubescens n. sp.—Plate XXV, figs. 37–41.—Rod-masses reddish, rods slender, irregularly curved, $3-7 \times .4\mu$. Spore masses scattered, drop-like, flesh-colored to dull orange, deep crimson when dry, at first coherent, becoming deliquescent, 150μ—1 mm. in diameter, often confluent. Spores round, 1.5—1.2μ in diameter.

On various decaying substances, lichens, paper, dung, etc.

This species is so common and makes its appearance with

such constancy on laboratory cultures of horse dung that it seems hardly possible it should have escaped previous description as a chromogenous coccus. The only form which has been described on this substratum to which it could possibly be referred is *Micrococcus fulvus* Cohn[1]. This species appears however, to be a true Micrococcus and, judging from the specimen in Rabh. Alg. Eu. no. 2501, bears little resemblance to the present form. The drop-like masses are at first more or less coherent and may be transferred intact to a slide for examination; but they soon become deliquescent, adjacent guttulæ coalescing into viscous masses more than a millimeter in diameter. The variation from flesh-color to orange-red forms may indicate an additional species, the orange type retaining this tint in agar cultures without varying towards the flesh-colored form. The morphological differences if there are any, are, however, too slight to warrant a specific distinction.

Myxococcus virescens n. sp.—Rod masses greenish yellow. Rods as in M. rubescens. Spore masses clear yellow-green to green, 150–500μ in diam. Spores round, 1.8–2μ in diam.

On hen's and dog's dung, New England.

This species, which closely resembles the last except in color, is rather rarely met with on the substrata mentioned, forming rather smaller spore masses. When cultivated on potato agar it tends to lose its green color and become yellowish. The spores seem constantly larger than in the preceding species.

Myxococcus coralloides n. sp.—Plate XXIV, figs. 29–33.—Rod masses pale pinkish, thin. Rods slender, curved, 4—7 $\times .4\mu$. Spore mass firmly coherent, erect, variously branched or lobed, the lobes or branches usually tapering towards the rounded apex, flesh-colored, becoming bright pinkish when dry; maximum height 350μ, the lobes about 20–30μ in diameter. Spores spherical, 1–1.2μ in diam.

On decaying lichens, Cambridge, Mass.

This striking form made its appearance in laboratory cultures and was readily cultivated on lichens and potato agar. The coral-like form of the spore mass is very variable, presenting every imaginable variation from a simple papilla to a complicated structure similar to that represented in fig. 29.

In addition to the species above enumerated the writer has observed several others, among them a very minute and peculiar

[1] Cohn: Beitr. z. Biol. d. Pflan. 1, 3, p. 181.

form occurring on rabbit's dung, belonging to the Myxobacter group, and another on lichens near *Myxococcus coralloides*, but was unable at the time to observe any of them under cultivation. Further additions to the order are therefore certainly to be looked for.

Cryptogamic Laboratory of Harvard University.

NOTE.— **Myxobacter simplex** n. sp., for which I accidentally omitted to send manuscript will be characterized in the succeeding number.

EXPLANATION OF PLATES XXII–XXV.

The figures are drawn with few exceptions from specimens mounted in glycerine. The combinations used are as follows: Figs. 1–6, 12–16, 20–21, 24, 29, 34: Zeiss oc. 4. obj. A. Figs. 7–10, 17–19, 22–23: Zeiss ocul. 4. obj. D. Figs. 11, 26–28, 31–33, 35–36, 39–41: Zeiss comp. oc. 12, Leitz oil im. $\frac{1}{16}$. Fig. 31: Zeiss oc. 4, Leitz oil im. $\frac{1}{16}$. All figures reduced $\frac{1}{2}$ by photo-lithography.

PLATE XXII.

Chondromyces crocatus (B. & C.)

Fig. 1–6 successive conditions of cyst formation shown by as many individual specimens. Fig. 1. *a*, mass of rods just rising from substratum and becoming constructed at its base. *b*, smaller mass which has begun to secrete a cystophore and has become two-lobed preparatory to branching. Fig. 2. A more advanced specimen, the mass preparing to produce three branches. Figs. 3, 4. Nearly mature cystophores showing branching of the third and fourth order, the ultimate masses beginning in some instances (*a*, *a*) to bud out into cysts. Fig. 5. Specimen cultivated on moist agar, the cystophore unusually stout, the ultimate masses almost wholly converted into immature cysts. Fig. 6. Specimen grown on straw showing normal habit; the cysts not yet mature.

PLATE XXIII.

Chondromyces crocatus (B & C.)

Fig. 7. Optical section of ultimate rod mass from which the rods have for the most part migrated into the immature cysts. Fig. 8. Three ultimate branches of a cystophore, one of them with three mature cysts still *in situ*. Fig. 9. Tip of an ultimate branch of a cystophore on which two cysts still *in situ* have germinated to produce secondary cystophores and cysts (*a*, *a*). Fig. 10. Five detached mature cysts showing extremes of size under ordinary conditions. Fig. 11. Vegetative rods.

Chondromyces aurantiacus (B. & C.)

Fig. 12. Young cysts budding from apex of cystophore. (Living material.) Fig. 13. A more advanced stage, a central column of ascending rods surrounded by a gelatinous layer. (Living material.) Fig. 14. Three specimens from dried material one showing terminal rod-mass from which the cysts have not yet begun to bud. Fig. 15. Specimen from dried material showing furcate habit. Fig. 16. Mature specimen from dry material in which the cysts show lateral coalescence. Fig. 17. Three mature cysts. Fig. 18. Two cysts kept on moist wood for several weeks, preparing to germinate. Fig. 19. A similar cyst germinating.

Chondromyces lichenicolus n. sp.

Fig. 20. Mature cysts on short cystophores. Fig. 21. Rod masses rising to form cysts. Figs. 22–23. Mature cysts with short cystophores, showing lobulation and coalescence.

PLATE XXIV.

Chondromyces serpens n. sp.

Fig 24. General habit of coalescent cysts.

Chondromyces aurantiacus (B. & C.)

Fig. 25. General appearence of a portion of rod mass growing in fluid agar. Fig. 26. Living rods from active rod-mass. *a*, rod dividing. Fig. 27. Vegetative rods in glycerine (*a*) showing granular contents stained with borax carmin. Fig. 28. Rods isolated in mature crushed cysts.

Myxococcus coralloides n. sp.

Fig. 29. Highly developed spore mass. Fig. 30. Spore mass of a different form more highly magnified. Fig. 31. Spore mass rising from rod mass at its base. Fig. 32. Vegetative rods. Fig. 33. Mature spores. *a*, spores in process of formation.

PLATE XXV.

Myxobacter aureus n. sp.

Fig. 34. General habit showing four cysts embedded in gelatinous matrix. Fig. 35. Rods (living) from rising rod-mass. Fig. 36. Rods from cysts crushed at maturity.

Myxococcus rubescens n. sp.

Fig. 37. General appearance of young spore mass viewed from above and surrounded by vegetative rods. Fig. 38. Normal habit of spore mass viewed laterally. Deliquescence beginning at the top. Fig. 39. Vegetative rods. Fig. 40. Different stages of supposed spore formation. Fig. 41. Mature spores.

Development of the flower and embryo-sac in Aster and Solidago.

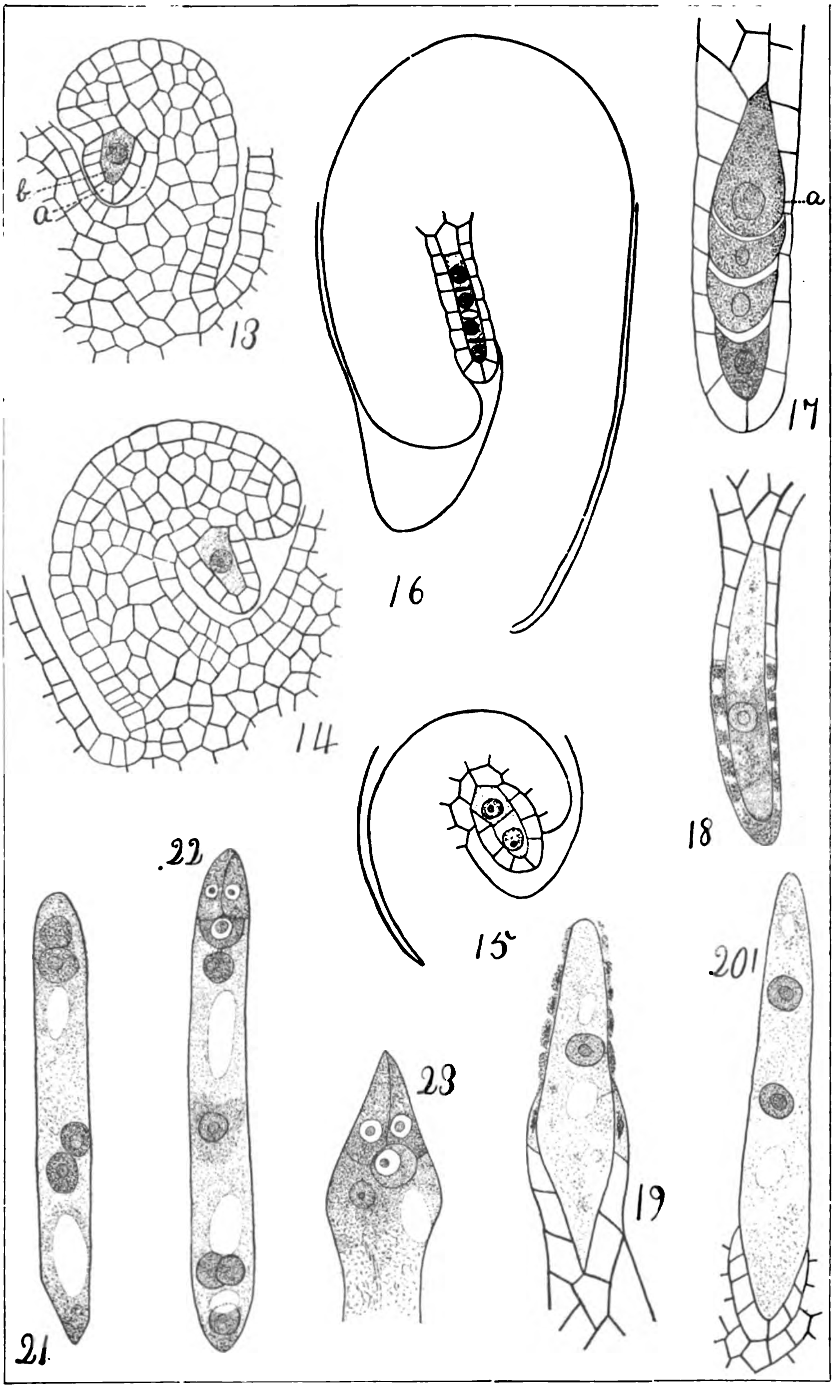
G. W. MARTIN.

(WITH PLATES XIX AND XX.)

Concluded from page 358.

Let us now turn to the development of the ovule and the embryo-sac. A short time before the floral organs attain their maximum length, there appears at the bottom of the ovarian cavity a rounded excrescence; this is the incipient ovule, the promise of a future seed (fig. 11).[6] This incipient ovule does not arise from the bottom of the ovarian cavity, but a little above the lowest point. Therefore, the ovule is not the terminal structure on the floral axis. For, by careful focusing, the apex of the fascicular system is seen to end very abruptly at the bottom of the ovary cell. To the right and left of the axial bundle of the pedicel, a little below the apex, are given off fibro-vascular bundles which traverse both sides of the carpellary leaf. It is in the region of one of these lateral bundles, beneath the epidermis, that the primitive cells develop, which arch upward and give rise to the funiculus and the nuclear ovule. Subsequently, a branch of this lateral bundle

[6]The ovule somewhat advanced.



MARTIN on ASTER and SOLIDAGO.

enters the funiculus. According to the investigations of Sachs and others, made upon the Compositæ, we have the assertion that the nuclear ovule is a lateral out-growth of the funiculus, but this statement could not satisfactorily be verified by my study of the two genera under investigation. As to the question whether the ovule is a lateral outgrowth on the flower axis there can be no doubt.

So far as could be determined no trace of evidence showed the ovule to be a direct outgrowth on the axis, but on the other hand, an outgrowth on the leaf. Returning again to the early growth of the ovule, as before stated, that it first appears as a rounded excrescence surmounting the funiculus. At first the ovule consists of a mass of cells, the tissue of which is soft and cellular, and is designated the nucleus of the ovule or the nucellus. By further development a large nucleated cell appears within this nucellar tissue, which soon divides, the apical cell of which becomes the mother-cell of the embryo-sac (fig. 12a). In its early development the nucellar body is almost orthotropous, but by further growth it becomes curved (caused by a stronger growth on one side) at the point (base of the nucellus, where the integument originates (fig. 12 b)[7]. At first the integument appears as an annular ring; as growth takes place it forms a complete wall around the nucellus; as the wall encroaches upon the apical portion of the nucellus, the latter becomes more and more curved, but does not seem to be wholly inverted till the integument completely surmounts it, even passing far beyond the nucellar apex (fig. 16). Thus, we have an ovule which is anatropous; having a single integument, though very thick and forming the greater mass of the ovule before fertilization is accomplished, investing a small central portion, the nucellus (fig. 13a)[8]; and the latter, which consists of but one layer of cells, in turn surrounds a more central portion, the embryo-sac (fig. 13b). Originally, this sac consists of but a single nucleated-cell, which, when division is complete, forms a central row of four cells (fig. 16). The nucellus in process of growth becomes very much elongated; its cells are well defined and nucleated; likewise the mother-cell of the embryo-sac, though primitive-

[7] Advanced stages of the ovule.

[8] At this point it may be stated that the integument does not develop on the side next the funiculus; this is common with anatropous ovules.

ly polyhedral in outline, but later more oval in contour, elongates and contains a nucleus with nucleolus imbedded in a rich mass of protoplasm. In some sections the nucleus appeared to be elongated in the same direction as that of the embryo-sac. During the subsequent growth of the integument and nucellus the embryonal sac enlarges (figs. 13 and 14), and the nucleus of the mother-cell undergoes subdivision. In fig. 15 the nucleus has divided, and the mother-cell is now separated into two equal parts by a transverse wall, each part containing a nucleated-cell. Presently, the two nuclei divide, a transverse wall is formed in each half, and thus we have, at the end of the second and last subdivision of the mother-cell of the embryo-sac, four equal nucleated-cells (fig. 16). At this stage of the embryo-sac there is a very close analogy to the division of the mother-cell into four cells, worked out by Strasburger in Polygonum and Senecio. The cross walls formed between the cells are very strongly refractive and much swollen; the middle transverse wall is remarkably distended and persists much longer than the other two partitions; in several sections the middle wall was found intact when the coutents of the cells were completely absorbed.

Of the four cells into which the primitive mother-cell of the embryonal sac is now divided, only the lower one is characterized by further growth;[9] this cell, therefore, becomes the true mother-cell of the embryo-sac (fig. 17, *a*). Subsequently, the protoplasm of the upper three cells becomes viscid, the nuclei show disintegration, and the upper wall of the lower, club-shaped cell (mother-cell) indicates a rigid turgescence. When the upper three cells begin to disorganize (in centrifugal order), they become crescent-shaped; their nuclei disappear, their walls are displaced, and the cell contents are absorbed by the encroachment of the lower, mother-cell. After the cells are completely disorganized and absorbed, the mother-cell assumes a central position in the embryo-sac (fig. 18). Simultaneously with the obliteration of the upper cells of the embryo-sac, the one-cell-layer of the nucellus undergoes a similar process of disintegration. The first mark of displacement is shown by the reduction of the cell contents to a granular protoplasmic mass; then follows the disappearance

[9] The micropylar end is known as the upper extremity of the ovule, while its opposite is the lower end.

of the transverse cell walls (fig. 18). The order of nucellar displacement begins at the apical end of the nucellus and proceeds toward its basal portion (fig. 19); finally, the whole nucellar-tissue is displaced and absorbed by the embryo-sac, which subsequently becomes very much enlarged. In fig. 19 is seen a partial obliteration of the nucellus and at this period of growtn the embryo-sac is completely filled with protoplasm, in the central portion of which is located the mother-cell with a vacuole both above and below it. Fig. 20 shows a complete displacement of the nuçellus and elongation of the embryo-sac; a farther separation of the vacuoles; the first division of the mother-cell into two daughter cells, each moving, the one into the upper, the other into the lower end of the embryo-sac. In the next stage of development we have the first division of the polar nuclei, thus making two nuclei in each end of the embryo-sac. The two upper nuclei rest within an accumulation of protoplasmic substance, while the two lower nuclei rest within a less dense plasma between an upper and a lower vacuole which show a longitudinal expansion (fig. 21). Previous to the last division of the polar nuclei, a longitudinal increase of the whole embryo-sac takes place. Subsequently, each of the two nuclei divide and we have four nuclei occupying opposite extremities of the embryo-sac. Thus, division is complete, and the upper cells give rise to the egg-apparatus, while the lower are designated antipodal cells. The next stage of development, as in fig. 22, is characterized by the ascent of one of the antipodal cells toward the center of the embryo-sac. This nucleus is imbedded in a dense mass of protoplasmic material separating two large vacuoles. Of the three antipodal cells remaining, the two upper, which lie alongside and impinge on each other, also rest in a plasma bridge separating two vacuoles, the upper of which is the larger and the lower one of the two previously mentioned. The lowermost cell is partly obscured by the impingement of the lowermost vacuole. At the micropylar end of the embryo-sac the cells have a far different significance; one of the cells in its descent toward the center of the sac meets its fellow from below and both coalesce, thus forming a secondary or endosperm nucleus. The three remaining cells, though naked like the three opposite, but surrounded by a denser mass of protoplasm, constitute the true egg-apparatus. The two upper

cells of the egg-apparatus, which lie side by side occupying the whole tapering anterior end of the embryo-sac, are the synergidae; at their lower extremity, extending nearly across the sac, lies a larger rounded cell, the oosphere. In further development, as found in fig. 23, the embryo-sac becomes very much swollen, which is a characteristic feature both before and after the process of fertilization. But fertilization in this case has not yet been accomplished, as the perfectness of outline of the synergidae amply testify. The upper vacuole of the preceding figure shows a contraction toward the upper extremity of the embryonal sac and is more oval in outline. At this stage, also, the upper polar nucleus exhibits retarded action in its descent toward its counterpart from below, in many cases refusing descent till after or about the fertilization period.

To trace the embryonal sac in its further development would result in recounting what, already, is very familiar to many botanists.

Summary.—I. The calyx appears second in order of succession of the floral whorls.

II. The syngenesious anthers seem to be united structurally.

III. The upper polar nucleus shows a slow descent in uniting with the lower one to form the endosperm nucleus.

IV. Compared with Strasburger's study of Senecio the following differences were observed:

(1) The antipodal cells occur in no regular order, and as far as my investigations went, were never found arranged in a single longitudinal row.

(2) No more than four antipodal cells could be discovered, always naked and having no cross walls.

(3) The oosphere, as far as could be determined, failed to occupy the whole diameter of the embryo-sac.

(4) The nuclei of the cells composing the egg-apparatus seemed always to occupy an almost central position.

(5) Vacuoles were seldom seen in the synergidae.

All figures illustrating the development of parts given are from sections supposed to pass through the center of the tissue which they represent.

All material used was fixed in 1 per cent. chromic acid 24 hours, thoroughly washed, stained *in toto* with alum carmine 24 hours, again washed and dehydrated; then taken through

the xylol-absolute-alcohol process into a saturated solution of xylol and paraffine, then infiltrated with paraffine, imbedded, and sectioned with a microtome; again, the sections were counter-stained on the slide with Bismarck brown and mounted in xylol-balsam.

Acknowledgments are due Dr. John M. Coulter and Mr. D. M. Mottier of Indiana University for their valuable suggestions given in the direction of my work.

Indianapolis High School.

A vacation in the Hawaiian islands.

DOUGLAS HOUGHTON CAMPBELL.

As the vacation approached, the question arose, "Where shall I go for the summer?" With the numerous interesting regions within comparatively easy reach of San Francisco, this question was not to be answered without some deliberation; but finally the Hawaiian islands were decided upon, as promising much of interest, both botanical and otherwise.

Hillebrand's Flora of the Hawaiian islands was procured; from it I obtained some idea of what might be expected in the way of vegetation, and with much interest I looked forward to the moment when, for the first time, I should find myself roaming in a tropical forest.

On the 6th of July, behold me, then, a passenger on the Australia, bound for Honolulu. There is very little to record of the voyage, which was pleasant enough but not eventful. One is struck by the paucity of life in the Pacific after getting away from the immediate vicinity of land. None of the giant kelps, so characteristic of the coast region, were seen after the first day out, nor was any floating sea-weed observed during the trip. Animal life was confined to a few sea-birds, mostly "gonies," small brown albatrosses, which followed the ship for several days. As the warmer waters were reached, flying fish became abundant, but they were pretty much the only animals noted on the way over. Not a vessel of any kind was seen after the first day, and the vast stretch of blue water was unbroken by any sign of life. The water is enormously deep, and of a blue so vivid, that one can almost believe that a handkerchief dipped into it would come out blue.

On awakening upon the seventh day out, and looking through the port-hole of my state room, I saw that we were sailing near land. Rugged barren looking hills were seen; and, going upon deck, I learned that this was Oahu, the island upon which Honolulu is situated. As we skirted the shore at a distance, I soon spied a grove of unmistakable cocoa palms, the first hint of the tropical vegetation to which I was soon to be introduced. Beyond was the bold promontory of Diamond Head, an extinct volcanic crater, forming a great bowl with rugged sides, right at the water's edge. Beyond this, and bounded partly by it, is the bay upon whose shores stands the city. Back of it rose abruptly a chain of mountains, in places about three thousand feet above sea-level, and furrowed by deep valleys, whose walls, as well as the cloud-capped summits of the hills, were covered with the most wonderfully verdant vegetation. Never before had I realized the possibilities of green. Blue greens, yellow greens, gray greens, and positive greens, with all degrees of these and others that are indescribable, combined to form what Whistler would term a symphony in green.

As if to vie with the colors of the mountains, the sea exhibited an equally wonderful variety of tints. Outside the harbor is a coral reef, and within this the water is of the pale green common to shallow ocean water; but outside it deepens very rapidly into the vivid blue of the open ocean. From a distance the line is clearly seen; but, as the observer approaches shore, the water changes from deep blue through every shade of blue and green until the pale green of the water within the harbor is reached.

As we approached land numbers of the queer outrigger canoes of the natives were met, and from the wharf boys jumped into the water and swam about the ship in the hope of persuading some of the passengers to throw over to them coins, which they are very skillful in diving for.

On the way to the hotel a few gardens were passed, and in them everything was strange. By far the most striking thing was the superb Poinciana regia. Although I had never seen this before I recognized it in an instant from a description of Charles Kingsley's, read long ago. Surely in the whole vegetable kingdom there is no more splendid plant. A spreading flat-topped tree, perhaps thirty feet high, with feathery green, acacia-like foliage and immense flat clusters of big

flaming scarlet flowers that almost completely hide the leaves so that the tree looks like an immense bouquet. They were in their prime about the time of my arrival in Honolulu and continued to flower more or less for the next six weeks. Pretty much everything in Honolulu, except the cocoanuts and an occasional haw tree (Paritium tiliaceum) is planted; but people seem to vie with each other in seeing how many different kinds of plants they can grow, and the result is that the place is like one great botanical garden. To Dr. Hillebrand this is said to be largely due, as he was one of the first to introduce foreign ornamental plants, and his place, which is kept much as it was at the time he left the islands, was a very remarkable collection of useful and ornamental plants from the warm regions of almost the whole globe.

Probably the first thing that strikes the traveler from the cooler regions is the great variety and number of palms. Of these the beautiful royal palm (Oreodoxa regia) is easily first. With its smooth columnar trunk, looking as if it had been turned, encircled with regular ring-shaped leaf-scars, and its crown of plumy green leaves, it well deserves its name. Other characteristic palms are various species of betel palms (Areca), wine palm, (Caryota), sugar palm (Arenga), and a great variety of fan-palms of different genera. None is more beautiful than a thrifty young cocoa palm, but unfortunately it is very subject in the Hawaiian islands to the ravages of some insect which eats the leaves and often renders them brown and unsightly. Indeed, it is almost impossible to find a specimen which is not more or less disfigured by this pest. The trunk of the cocoanut tree is usually more or less crooked, and in old specimens much too tall for its thickness, so that the old trees look top-heavy. The date palm flourishes in Honolulu, where it is quite dry, but does not do so well in the wetter parts of the islands.

On studying the other trees, one is struck at once by the great preponderance of Leguminosæ, especially Cæsalpineæ and Mimoseæ. All about the town, and growing very rapidly, is the algaroba (Prosopis juliflora), a very graceful tree of rapid growth, with fine bipinnate leaves and sweetish yellow pods, which animals are very fond of, and which are used extensively for fodder. Add to this that the tree now forms the principal supply of fuel for Honolulu and we can realize its full value. Other leguminous trees that are planted are

the monkey-pod (Pithecolobium samang), tamarind, various species of Bauhinia and Cathartocarpus. One species of the latter with great drooping bunches of golden yellow flowers and enormous cylindrical pods three or four feet long, rivals the Poinciana when in full flower.

Mingled with these are a great number of shrubs and trees with showy flowers or leaves, most of them more or less familiar to the stranger, either from pictures or from greenhouse specimens. Several species of Musa are grown, and when sheltered from the wind are most beautiful; but ordinarily the leaves are torn into rags by the wind. The tall and graceful M. sapientium has been largely supplanted by the much less beautiful Chinese banana, M. Cavendishii, which is short and stumpy in growth, but enormously prolific. The related traveler's tree (Ravenala Madagascariensis), is a common and striking feature of many Hawaiian gardens. Of the many showy flowering shrubs, the beautiful Hibiscus Rosa-Sinensis is one of the commonest, and is used extensively for hedges. One of the most striking hedges in the city, however, is the famous one at Puna Hou college, which is 500 feet long and composed of night-blooming cereus. I was not fortunate enough to see this when it was in full flower, but I saw a photograph of it when it was estimated that there were about 8,000 flowers at one time.

Of the fruit trees ordinarily grown, the following may be mentioned. The mango is a very handsome tree with dense dark green foliage and masses of yellow and reddish fruit on long hanging stalks. The bread-fruit tree is common, both cultivated and wild, and is a very beautiful tree of moderate size with leaves looking like immense fig-leaves, and the fruit like a large osage orange. I saw no ripe fruit, and so had not an opportunity of testing its quality. Guavas of different varieties are extremely common both wild and cultivated, and the various fruits of the whole citrus tribe grow well. The few specimens of temperate fruits were, for the most part, much inferior to those of the United States. Of the fruits that did not strike my fancy, at least at first, was the alligator pear (Persea gratissima), a big green or purple pear-shaped fruit with an immense single seed. The pulp is somewhat waxy in consistence and very oily. It is eaten as a salad, and very much relished by the islanders, but the taste is acquired. The curious papaya (Carica papaya) is another fruit which did not appeal to my palate. Its big orange fruit, not unlike a

melon in appearance when cut open, has a peculiar "squashy" flavor that suggested its having been kept a day too long.

Many showy climbers are planted, some of which, like Stephanotis, Thunbergia and Allamanda, are superb; but there is one that is particularly obnoxious in color, Bougainvillea, whose magenta floral-bracts are an offense to the eye, forming a cataract of raw color. It looks, as some one observed, as if it had just come from a chemical bath.

As soon as one gets fairly away from the city, it is at once seen that all the luxuriant vegetation is strange. Along the seashore is a plain gradually rising into low hills, both almost destitute of trees, except here and there a few cocoa palms along the shore. Of the strictly littoral plants among the most conspicuous is the curious Ipomœa pes-capræ, with deeply two-cleft leaves and purplish pink flowers. In the fertile lowlands near the sea are the principal cane and rice fields, which with taro are the staple crops. The rice is cultivated entirely by Chinese, near Honolulu; but on the sugar plantations the Japanese are largely employed. To see a Chinese laboriously transplanting little handfuls of rice into straight rows, or plowing in the mud and water with a primitive plow drawn by a queer Chinese buffalo are sights very foreign to an American eye. Sugar cane is eminently productive in the islands, and, hitherto, has proved the main source. of revenue; but now the Hawaiians are bewailing the depression caused by the free admission of sugar from other countries into the United States; as, hitherto, their product has enjoyed practically a monopoly of the American market, having been admitted by treaty free of duty.

I made several trips up the valleys back of the city, but owing to the almost constant rain in many of them, these were not always agreeable. However, one is richly repaid by the luxuriance and variety of the vegetation. For a mile or two we pass between grass-covered hills, or hills overgrown in places with the lantana, which, introduced as an ornamental plant, has become a great pest. This plant covers some of the hills with an absolutely impassable thicket and spreads very rapidly, so that it is a serious problem what is to be done with it. Of the common roadside plants, an orange and yellow milk-weed and the showy white Argemone Mexicana were the most conspicuous. As one proceeds farther, where more moisture prevails, the variety becomes larger. Thickets of Canna and a Clerodendron with double rosy-white flowers,

are common, and the curious screw-pine (Pandanus odoratissimus) is occasionally seen. This latter is a very characteristic plant, but is much more abundant in some of the other islands. In this region several very showy species of Ipomœa are very common, among them the well-known moon-flower, I. bona-nox.

With the increase in moisture, as might be expected, the mosses and ferns increase in number and beauty. There are many of them of types quite different from those of the United States. One of the commonest ferns of the lower elevations is Microlepia tenuifolia, a very graceful fern with finely divided leaves and terminal sori. Species of Vittaria, with very long undivided leaves, are also common here.

As we ascend one of the commonest ferns is Sadleria cyatheoides, a very large fern, often more or less arborescent. Ascending still higher the number and variety of ferns increases rapidly, and many beautiful and interesting ferns and mosses aud liverworts become common.

At about one thousand feet elevation we begin to meet with species of Cibotium, to which genus belong the largest of the tree ferns of the islands. Here, also, I met for the first time with the smallest of all the ferns I have ever seen, Trichomanes pusillum. This dainty little fern, one of the Hymenophyllaceæ, forms dense mats on rocks and tree-trunks, looking like a delicate moss. The full grown frond is fan-shaped and, with its stalk, is not more than half an inch high. These tiny leaves, nevertheless, in many cases bore sporangia.

With the increase in the amount of moisture, the epiphytic ferns become frequent. The principal ones we notice are species of Acrostichum, Polypodium, and, most conspicuous of all, the beautiful bird's-nest fern (Asplenium nidus), with immense bright green entire leaves. This superb plant is not at all uncommon in the forks of trees in the lower forest region.

Everywhere in this region are thickets of Freycinetia, sometimes even climbing the trees. This plant, looking very much like a Pandanus, is troublesome to get through, and often have we found ourselves walking on the tops of the bushes, three or four feet above the ground. As frequent tough convolvuli and ipomœas kept entangling our legs, progress was rather slow.

(To be concluded.)

Leland Stanford Junior University.

BRIEFER ARTICLES.

Carl Moritz Gottsche.—Carl Moritz Gottsche, who died Sept. 28th, at Altona, near Hamburg, was born there July 3, 1808. He has been a practicing physician in his native village for over a half century, and during an equal period, an ardent student of the Hepaticae, issuing a large number of publications thereon which vary from a few pages of critical notes to elaborate monographs. From his first serious publications in 1843–5[1] down to his work in recent years there cannot be said to be a single careless issue from his hand. In order to more satisfactorily illustrate his papers, he early learned the art of the engraver and his success in this direction can best be seen in his papers, especially in the matchless plates of his *Mexikanske Levermosser.*

His botanical interest commenced with the group he continued to study. In fact his contributions to other botanical fields are scarcely worth mentioning in comparison. His first papers were chiefly morphological and dealt on the one hand with that curious link between the thallose and foliose Hepaticæ, *Haplomitrium Hookeri*, and the equally curious but scarcely circumscribed marsupiocarpous Hepaticae which he called "Jungermanniae Geocalyceae." In 1844–1847 appeared the Synopsis Hepaticarum which was the combined work of Gottsche and two older men, Lindenberg and Nees von Esenbeck. Although the former had published a monograph of the European species as early as 1829[2] followed by the more elaborate one by the latter in 1833–38,[3] Gottsche's name appears first on the title page and it is evident that he did a large part of the work. This work contains descriptions of over 1600 species of Hepaticae and is the last summary of the group that has appeared, although the number of known species has more than doubled. He was further associated with Lindenberg in the publication of Species Hepaticarum (1839–51), an elaborate work attempting to illustrate all the known species, which for lack of support stopped short with the genera Plagiochila, Lepidozia and Mastigobryum [Bazzania]. In 1856 he became associated with Rabenhorst in issuing exsiccatæ of European Hepaticæ (Hepaticæ Europeæ) which extended to 66 decades (nos. 1–660), and which owe their chief value to Gottsche's elaborate notes and icones which appear on the labels to the specimens. It is unfortunate that the numbered specimens of this series were often carelessly put up and sometimes badly mixed; while

[1] Anatomisch-physiologische Untersuchungen über Haplomitrium Hookeri (1843). Ueber die Fructification der Jungermanniæ Geocalyceæ. (1845). Both papers were published in Acta Acad. Caes.-Leop.

[2] Synopsis Hepaticarum Europaearum. 4to. Bonn, 1829.

[3] Naturgeschichte der europäischen Lebermoose. 4 vols, 12° ., Berlin and Breslau, 1833–38.

this was in no way the fault of Gottsche, it detracts from the value of his notes not to have with them, in each case, samples of the same plant on which the notes were made.

While we have not space here to mention all of Gottsche's work[4], we must call attention to two of his papers that are of special interest to Americans. The first is on the Hepaticæ of the U. S. of Columbia[5] and the second is on Hepaticæ of Mexico[6] and more especially bears on our own flora. Both are elaborate works, both are elegantly illustrated by Gottsche's own hand, in both the flora is very fully represented and the monographs constitute a broad and substantial beginning to any further study of the Hepaticæ of these lands. Unlike so many pioneer works, no time will have to be squandered over two or three line descriptions in order to ascertain what was most likely intended by the describer, for the descriptions are as carefully written as the drawings are elegantly engraved.

Dr. Gottsche leaves an extensive herbarium made all the more valuable by his elaborate sketches of the species which he invariably made in his study of any form. Better than all else he leaves a memory which extends over half a century of friendly help he has freely given to students of the Hepaticæ in all lands.—L. M. U.

An edible lichen not heretofore noted as such.—*Endocarpon miniatum* Schaer. has been collected by me in many states, and is abundant in Tennessee. It has also been sent to me from Japan and Cuba, two widely diverse localities. It inhabits calcareous rocks and may easily be mistaken for *Umbilicaria*, two species of which it resembles. I doubt if any writer has noticed or commended this lichen as an article of diet. But Mr. Minakata, who is a distinguished scholar and naturalist, and who has lately spent two years in the United States in study and travel, informs me that large quantities are collected in the mountains of Japan for culinary purposes, and largely exported to China as an article of luxury. He expresses surprise that no attention is paid to it here. The name by which it is known in Japan is *iwataka*, meaning "*stone-mushroom.*" Properly treated it resembles tripe.—W. W. CALKINS, *Chicago, Ill.*

A new Tabebuia from Mexico and Central America: Tabebuia Donnell-Smithii n. sp., PLATE XXVI.—A tree 50 to 75 feet high, often 4 feet in diameter: leaves palmately-compound on long peduncles 5 to 10

[4] As we are so soon to publish a full bibliography of the Hepaticæ, a complete list of Dr. Gottsche's writings will there be given.

[5] Hepaticæ in Triana et Planchon: Prodromus Floræ Novo-Granatensis. Ann. des Sc. Nat., 5th ser., I. 95–198, t. XVII–XX (1864).

[6] De Mexikanske Levermosser, efter Prof. Fr. Liebmann's Samling. Dansk. Vid. Salsk. Skrift. VI, 97–380, t. I–XX (1867).

C. E. Faxon, del.

B. Meisel, Lith Boston.

TABEBUIA DONNELL-SMITHII, ROSE.

inches long; leaflets 7, very variable in size (the largest on petiolues 1 to 3½ inches long), oblong to ovate, acuminate, rounded or truncate at base, serrate, glabrate in age, 2 to 10 inches long, often 3 inches broad: flowers arranged in a large terminal panicle of small cymes, 8 inches long, with short glandular-pubescence throughout: cymes few-flowered, with deciduous scarious bracts; pedicels 6 lines long: calyx closed in bud, deeply cleft and two-lipped in flower, 6 lines long: corolla yellow, tubular, 5-lobed; tube 1 to 1½ inches long; limb 1½ inches broad: stamens 4, included, didynamous; filaments incurved, glabrous except at base; anther cells glabrous, oblong; sterile filament 1½ lines long: ovary sessile: pods 12 inches or more long, 10-ribbed, glandular-pubescent and loculicidally dehiscent: seeds in 2 rows.—Common on the mountains about Colima and cultivated about the town. Collected by Capt. John Donnell Smith, at Cuyuta in the Department of Escuintla, at an alt. of 200 feet, April, 1890, no. 2070; and, also, by Dr. Edward Palmer, at Colima, Jan. 9 to Feb. 6, 1891, no. 1098.

This is said to be one of the most beautiful trees of Mexico, and is called "primavera." The flowers are a beautiful golden yellow produced in great abundance, and generally appearing before the leaves. The trees are often large, sometimes 4 feet in diameter and the wood very valuable. The trees are cut into logs about 12 feet in length, and shipped from Manzanillo in the state of Colima to the United States, principally to Cincinnati and San Francisco where they are used a great deal for cabinet work and veneering. The tree is very common in the lower part of the Department Escuintla; it is tall and slender, usually leafless, and with the profuse delicate yellow flowers standing out against the sky like golden clouds.

The following note is from a letter of J. D. Smith, Jan. 7, 1892: "The trees were too branchless for my servant to climb, too stout for him to fell with his machete, and too high for me to discern what manner of leaves were those which occasionally showed themselves among the flowers. My flowers were all picked up on the ground. I think there must be many trees in those countries, of which botanists have not been able easily to collect specimens, and which, therefore, remain unknown."

I have not been able to place in any known species this interesting tree. It seems curious that a tree so widely distributed, of such attractive flowers and of some commercial importance should have remained unknown to botanists. The species, while not agreeing in all respects with *Tabebuia*, answers better to this than to any other known genus. In its inflorescence and ribbed pods it is more like *Godmannia* or *Cybistax*, but does not agree in other particulars.—J. N. Rose, *Dep't of Agriculture, Washington, D. C.*

The occasional cross.—When in 1876 I addressed the meeting of the American Association for the Advancement of Science at Detroit,[1] taking for my text what I then regarded as an extravagance, the exact language of a great teacher in science: "All plants with conspicuously colored flowers, or powerful odors, or honeyed secretions, are fertilized by insects; all with inconspicuous flowers, and especially such as have pendulous anthers, or incoherent pollen, are fertilized by the wind" I did not expect to see the proposition so widely modified as it is to-day. Our great leader, Asa Gray, wrote to me reiterating the strength of the position I was combating, and in the curt way quite allowable in the correspondence of friends whose regard for each other no difference of opinion could weaken, "dared" me to produce an instance of a flower as above characterized, that was not arranged for cross-fertilization. It was chiefly this "daring" that has led me in recent years to produce the instances. The broad view soon became modified so as to read that the plants were so arranged as to pollinate themselves in many instances when insects failed to do the work, and I doubt very much whether there is a prominent botanist to-day, who will deny that there are numerous instances in which sweet and colored flowers are so arranged that cross-fertilization is next to impossible. Indeed it has come to be quite frequent for authors on the relations between flowers and insects, when noting the contradictive facts to simply observe that an "occasional cross is not improbable."

It may not be useless at this stage of the progress of thought to inquire, what is the physiological value of an "occasional cross"?

No one familiar with nature can fail to see that, of the millions of seeds annnally produced by plants, an almost imperceptible fraction only come to seed bearing individuals, and the seeds from the "occasional cross" can scarcely have any record in the progressive history of the race. Suppose we take Mr. Robertson's illustration of *Mollugo verticillata* (p. 274). I am satisfied that the "occasional cross" never occurs, and that "spontaneous self-pollination may take place" is putting the case with gratuitous mildness. A microscope would show that not only are the pollen-sacs disrupted and the pollen discharged over the pistil before the flower opens; but so long that the ovarium has commenced to assume the brown tint of ripeness, and the seeds, with full cotyledons, have reached their full size. But suppose this not to be the case, what chance has an "occasional cross" to get the resultant seeds into the reproductive stage again? I have before me a single plant of less than average size. It is one-sided, and extends over half a circle with a twelve inch radius. I find in one seed vessel just 30

[1] See Proc. Am. Ass. XXIV. p. 224.

seeds, and there have been already matured or on the road to maturity 372 seed vessels, with 11,160 seeds. How many of these would get through the long chapter of accidents and produce flowering plants next year? I venture to say not a hundred—possibly not ten. What chance has an "occasional cross" to benefit the race in a scheme like that proposed?

And then we find that those which get more than an "occasional cross" do not get along any better for it. Take Mr. Robertson's illustrations again. *Gaura biennis* I believe to be more dependent on insect aid than he himself has discovered, though none of those he names have any hand whatever in it, while its close ally *Gaura parviflora* is just as absolute a self fertilizer. And if *Œnothera fruticosa* is so arranged that self-pollination is impossible—a fact of which I am by no means sure—how about its neighbor *Œnothera biennis*, which is one of the closest self-fertilizers in the whole family, and yet has made its way not only all over the American continent, but has invaded the old world as well!

I repeat, where does the physiological advantage of the "occasional cross" come in?—THOMAS MEEHAN, *Germantown, Philadelphia.*

Sullivantia Hapemani.—In the November GAZETTE (p. 348), owing to undue haste in printing, this species appeared as a *Heuchera*. The oversight was unfortunate, but it is to be hoped that the correction can overtake the blunder. It is a matter of some interest to discover in our flora a third species of *Sullivantia*, and that, too, with range intermediate between that of the other two. *S. Ohionis* of the north central states (Ohio to Iowa and Minnesota) has always been considered a rare and interesting plant; and *S. Oregana* of the Willamette and Columbia Rivers still more so. This third species, from the Big Horn Mountains of Wyoming, well preserves the generic appearance, and would be recognized at a glance by those familiar with the other species, although much more closely related to its eastern congener, a thing to be expected. All three species affect the same situation; all being found growing in the crevices of dripping cliffs. In addition to the description in the November GAZETTE it may be added that the calyx-lobes are 3-nerved and bright green; the petals are obovate, entire, and brown at base; and the pod is broad and depressed at the partition. The species somewhat resembles *S. Ohionis*, but its lower habit, smaller and deeply cut leaves (the lobes acutely dentate), green and 3-nerved calyx-lobes, much broader obovate (not oblanceolate acutish) petals, and its broad and depressed pod make it very distinct.—JOHN M. COULTER, *Bloomington, Ind.*

EDITORIAL.

Those who are engaged in investigation cannot but regret the increasing tendency to the establishment by educational institutions of independent publications which are to contain the results of investigations conducted at the institution or by members of its staff. It is getting to be the fashion now for all the larger colleges and universities to undertake the issue of either occasional "bulletins," or "contributions," or "studies." The agricultural experiment stations have the issue of at least four bulletins in the course of the year forced upon them by an absurd law; but these newer publications are not stimulated by any thing except the desire of the institution to advertise itself. As soon as a college comes to have graduate students, and a faculty with the leisure and ability for original work, it feels that it must follow the example of other colleges, in order to let it be known that such work is in progress. There is no plea whatever that there is any necessity for the establishment of such publications except self-aggrandizement. It is not that worthy papers could not otherwise see the light; it is not that the regular journals and transactions of learned societies are unable or unwilling to care for the flood of manuscripts which might otherwise be poured upon them. Not that; it is solicitude on the part of the University of B——— lest the University of A——— should become greater in reputation, or should attract more students.

To one who is looking up the literature of any particular subject this multiplicity of irregular journals and bulletins and contributions and proceedings is simply maddening. In Germany this evil has become so great that almost every department of learning is compelled to have its *Jahresbericht* and *Centralblatt*, which have not only attempted to compass German but also all literature in their special fields. But the task is becoming herculean, and sooner or later subdivision either of territory or topic must be made. We are coming to a time, and that rapidly, when such indexes to American literature will be indispensable. Every new and especially every occasional publication adds to the difficulty of collecting or keeping informed of botanical literature. It was therefore with especial pleasure that we welcomed the beginnings of such indexing in the publications of the botanical division and the division of vegetable pathology at Washington.

The objection to the multiplication of publications is the stronger when it is seen that the benefit of advertising can be secured without the evil complained of. The plan long pursued by Drs. Gray and Watson of the Harvard Botanic Garden, and adopted by the Crypto-

gamic Laboratory of the same university, and by the Herbarium of Columbia College is warmly to be commended. The series of papers emanating from these places bears a uniform title and each paper its serial number and sub-title, of which the first article in this issue is an example. By this plan any institution which desires advertising can secure it and at the same time utilize the ordinary channels for obtaining publicity for its investigations.

Or the plan adopted by the Johns-Hopkins University in the publications of its "circulars," and the similar one lately put into operation by the University of Minnesota in its "Quarterly Bulletin" are even more to be commended. In these there appear abstracts of any papers published by students or members of the faculty, with references to the place of publication. They also give opportunity for the inclusion of accounts of university organization and work, and many items of interest to alumni and educators. They thus serve admirably to show what the institutions are doing, and as advertising media could not be improved; while at the same time, instead of adding to the scattered publications which must be kept track of, they actually help to direct the student to the literature he seeks.

By all means let the botanists of our larger institutions endeavor to prevent so far as possible the troublesome scattering of botanical papers.

CURRENT LITERATURE.

Western Grasses.

The "Grasses of the Southwest", lately completed, put into the hands of agrostologists 100 plates illustrating the chief species of the arid regions of the south western United States. It is quickly followed by part 1 of the "Grasses of the Pacific Slope",[1] in which fifty of the larger and economically important species are figured. The second part is expected to follow soon and when completed this will be the second volume of the "Illustrations of North American Grasses." Most of the species figured have not been illustrated before. The plates of this part are a decided improvement upon those of the second part of the first vo lume, even as these were better than the first. They are

[1] VASEY, GEORGE—Grasses of the Pacific Slope, including Alaska and the adjacent islands. Plates and descriptions of the grasses of California, Oregon, Washington and the northwestern coast including Alaska. Bulletin 13, Div. of Bot., Dep't of Agric. Issued Oct. 20, 1892. Imp. 8° pl. 50. Washington. Gov't Printing Office.

lithographs by Meisel, who undoubtedly does the best work in this line of any man in the country.

The descriptions are drawn up mostly by Mr. L. H. Dewey, an assistant botanist of the division.

We have much commendation for the work, and but two adverse criticisms. It is a pity that a fuller synonymy is not given, with critical notes. The plates are valuable indeed; but their value would be much enhanced by such study, with in some cases more minute and thorough dissection of flowers. However if we cannot have a whole loaf we ought to give thanks for the half.

The second criticism relates to purely mechanical details. The plates of the second part of the first volume were nearly ruined by close trimming and these are cut too close also. Why not leave edges uncut, so that one trimming when bound would suffice? Such plates deserve a broad margin, rather than a "skimpy" one.

A new publication.

The botanical laboratory of the University of Pennsylvania begins a new serial entitled "Contributions from the botanical laboratory of the University of Pennsylvania."[1] Several similar publications having come to our attention recently, together with propositions for the establishment of others, we are moved to give expression to our views in the editorial pages on the general advisability of such issues by educational institutions.

This first number is admirably got up. The typography and paper is excellent and the plates are good.

The longest paper is by Dr. Macfarlane on Dionæa muscipula and is directed to a study of the irritability of the leaves. This is followed by a short paper on bud propagation in Dionæa, which Mr. Harshberger found to occur occasionally in the inflorescence. There are two papers by Dr. Wilson, one on the dioecism and proportion of staminate and pistillate flowers in Epigæa repens; the other (with the assistance of Mr. Greenman) on the movements of the leaves of Melilotus alba and other plants. In these researches Dr. Wilson finds that Melilotus and many other plants have a "hot sun" position for their leaves which is dependent largely upon the heat rays and the water supply, since it is intended to protect plants from excessive evaporation. Dr. Rothrock has two short notes, one on a monstrous form of Rudbeckia hirta, and the other on a nascent variety of Brunella vulgaris. Finally there is a chemical paper on mangrove bark tannin by Dr. Trimble, who finds this tannin quite similar to that in horsechestnut, tormentil and rhatany.

[1] Philadelphia: Univ. of Pa. Press. 1892. vol. 1. no. 1. 8vo, pp. 73, pl. 13.

Minor notices.

THE SECOND BULLETIN of the U. S. Division of Vegetable Pathology[1] is devoted to a detailed preliminary report upon the California vine disease, which appeared in sufficient amount to attract attention in 1884 and 1885. Since then its spread has been rapid until 20,000 to 25,000 acres of vineyards in S. California have been devastated. The cause of the disease has not yet been discovered. This report gives an account of the incubation and spread of the disease; its characteristics and its relation to various supposed causes. It seems most nearly reated to *rougeot* and *folletage*.

PROFESSOR L. H. PAMMEL has distributed copies of an elaborately illustrated lecture on the "Pollination of Flowers"[2] delivered at the January meeting of the Iowa Horticultural Society. The collation of useful illustrations (though these are wretchedly printed) and the most important literature bearing on this subject makes the pamphlet a very useful one to teachers. Two other short papers, "Cross and self-fertilization in plants" and "The effects of cross-fertilization in plants" are also included in the pamphlet.

OPEN LETTERS.

The Botanical Congress.

Since opinions are asked regarding an American Botanical Congress at Madison next year, I give mine briefly and categorically as follows:

1. By all means we must have a congress. Foreign botanists are expecting it, the time is ripe for it, and properly arranged, I believe that we will be able to secure a large and representative foreign delegation.

2. The success of the congress will depend *very largely* on the selection of a *live* general manager or secretary who will not be trammelled in his action by too much *a priori* machinery. He must be given power to act, if necessary, promptly *because* independently.

3. Action should be taken at once to secure a meeting of the International Committee on Nomenclature appointed at Genoa, in connection with next year's congress.

4. A program containing a *few* topics of general interest to botanists throughout the world should be announced at an early date. Now that nomenclature is practically settled, we are in a position to appreciate the fact that there are other matters of more importance, some of which may well be discussed in such a presence.

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[1] Washington: Gov. Printing Office: 1892. 8°. pp. 222. pl. xxv. chart 2.

[2] Apparently privately printed. pp. 57. figs 45.

5. The date should be pushed to the very last of August or the first week in September in order to accommodate European botanists whose university duties would prevent attendance earlier.

6. A free excursion of reasonable length (say as far as Lake Superior) ought to be arranged for; to this, arrangements should be added whereby foreign delegates could secure special rates to our great attractions in the far west should they care to make such extended excursions.—LUCIEN M. UNDERWOOD, *Greencastle, Ind.*

NEWS AND NOTES.

MR. W. H. NORRIS describes in the *American Naturalist* for August the development of the ovule of *Grindelia squarrosa.*

MR. D. T. MACDOUGAL is arranging a collecting trip to Mexico. He will start early in January. Those desiring plants from this region can address him regarding the matter at LaFayette, Ind.

A NEW EDITION of Koch's "Synopsis Floræ Germaniæ" is to be published under the editorship of Prof. P. Ascherson. The Prussian Academy of Sciences has voted him 2,000 marks to carry on the work.

THE BOTANICAL DEPARTMENT in the Bohemian University at Prague has been strengthened by the appointment of Dr. A. Hansgirg, until now lecturer in the same institution, and Dr. R. von Wettstein, of Vienna, to professorships.

MR. F. V. COVILLE gives an interesting account of the Panamint Indians of California (Am. Anthrop. v. 351), in which there is much of botanical interest. The question as to what these desert Indians can find in the way of vegetable food is answered by a surprisingly long list of plants whose seeds are chiefly used.

IN THE LAST number of *Hedwigia* (heft 4, 1892) Dr. C. Warnstorf describes five new species of Sphagnum: *S. Labradorense* of the ACUTIFOLIA, from Labrador; *S. dasyphyllum* of the CUSPIDATA from Connecticut; *S. Orlandense* from Florida; *S. Mohrianum* and *S. Mobilense* from Alabama, the three latter of the SUBSECUNDA.

M. HENRY DOULIOT, preparator at the Museum of Natural History at Paris, is dead at the age of 38, from a disease contracted during a scientific expedition. M. Douliot had already aquired a wide reputation through his researches in the histology of the higher plants. His work has been largely in conjunction with M. Van Tieghem.

IN THE November GAZETTE, (p. 341) we inadvertently omitted mention of the fact that the Department of Agriculture was the body that Dr. Vasey represented at Genoa, in addition to the Smithsonian Institute. It is but just that this correction should be made since the Department was the financial authority for the mission.—L. M. UNDERWOOD.

AMONG THE REPORTS of the large scientific staff at work on the Government Experiment Farms at Ottawa, Canada, for 1891, just issued as an appendix to the report of the Minister of Agriculture, is one from Mr. James Fletcher, the Botanist. It is concerned chiefly with reporting concerning experiments with grasses, some of which are figured, and describing some of the most prevalent and dangerous weeds that Canadian farmers will be likely to encounter.

THE TECHNIQUE of celloidin inbedding will be found set forth *in extenso* in two recent articles; one by W. Busse in *Zeitschrift für wissenschaftliche Mikroskopie* VIII. 462–475; and the other in a series entitled Mikrotechnische Mittheilungen, by Ludwig Koch, of which the first installment appears in Pringsheim's *Jahrbücher für wissenschaftliche Botanik*, XXIV. 1–51, under the caption "Ueber Einbettung, Einschluss und Färben pflanzlicher Objecte."

A LIST of Ohio Uredineæ and a brief account of wheat scab, by Miss Freda Detmers, together with a short description of Lactuca Scariola, by C. E. Thorne, make up bulletin 44 of the Ohio Experiment Station. The list of rusts contains about 68 species. The hosts and localities are given, and also a few additional notes. There is evidence of a lack of careful proof reading, and the cuts illustrating Lactuca and wheat scab are wretchedly printed.

AN IMPORTANT monograph of one of the much neglected groups of lower plants, the Oscillarieæ, appears in the *Annales des Sciences Naturelles* VII, XV, p. 263–368, with five plates. This, with the earlier monograph of the heterocystic Nostocaceæ by Bornet and Flahault, gives tolerably complete facilities for the determination of these plants. If some one would now put into compact form an account of our American species with analytic keys it would be serviceable.

DR. BYRON D. HALSTED is soon to issue a century of weed-seeds. The seeds will be in convenient vials, held in a tray which is about the size of an herbarium sheet. Suitable printed labels are also distributed. This collection is designed to assist station botanists in determining the foul stuff in commercial seeds, and also for the use of seedsmen; but all botanists should be interested. The price per set is $10, which is far below the real cost, and Dr. Halsted may be addressed at the N. J. Experiment Station, New Brunswick, N. J.

MR. ERNEST WALKER, of New Albany, Ind., has made some interesting observations on the scattering of seeds by the pods of *Oxalis stricta*. In the proper condition, the least disturbance will cause the seeds to be expelled with considerable force, and thrown two or three feet. Mr. Walker finds that the outer seed-coat is the agent in this dissemination, being a translucent shining membranous envelope stretched tightly over the seed, suddenly and elestically turning inside out when it bursts. Further details can be had from Proc. Philad. Acad., 1892, p. 288.

THREE DISEASES of tomatoes grown under glass are described by Prof. L. H. Bailey (Bull. no. 43), as observed at the Cornell Experiment Station. The most serious one, called winter blight, appears to be of a bacterial nature. Growth is checked, the leaves show ill-defined yellowish spots, later turning dark, the leaf curls and becomes stiff, the edges drawing downwards, giving the plant a wilted appear-

ance. Common blight (Cladosporium fulvum) and root-galls, caused by nematodes, are also described and illustrated. The results of various preventive measures are given.

IN A CONTRIBUTION to the physiology of collenchyma (Prings. Jahrb. f. wiss. Bot. XXIV. 145) Jonas Cohn finds that this tissue normally contains in the cell wall from 60 to 70 per cent. by weight of water as against 20–40 per cent. in bast and wood. He holds that Bokorny's deductions as to the water-conducting function of collencyhma are founded on inexact experimentation and that C. Müller's idea that this is a water-storing tissue is likewise unsatisfactory. He was unable, however, to discover the relation between the mechanical peculiarities and the watery contents of collenchyma, and therefore does not suggest any theory as to its function.

MR. H. J. WEBBER and Mr. W. T. Swingle are now at Eustis, Lake county, Florida, where a laboratory is being erected and fitted up for conducting experimental work on the anatomy, physiology and pathology of subtropical economic plants. The first important task is to learn something of Citrus fruits. Mr. Swingle has been working on the diseases of Citrus for the last two years. These observers are now starting at the base of matter in the orange blight investigation, and are just starting experiments on the transpiration of healthy and diseased plants, coupled with a histological investigation of the leaf and conducting tissue of healthy and diseased limbs.

THE UNIVERSITY OF ILLINOIS lately completed a new building for the departments of botany, zoology and geology which was formally dedicated as "Natural History Hall" on November 16th.

The exercises included addresses upon the development of the natural history departments, by Professor T. J. Burrill; science and the American college, by President David S. Jordan, of Leland Stanford University; the laboratory as a necessary part of the college equipment, by Professor William Trelease, Director of the Shaw School of Botany; and the methods of geology, by Professor N. H. Winchell, State Geologist of Minnesota. The botanical laboratories are said to be admirably arranged and adapted to the needs of instruction and investigation.

MR. ELLIOTT COUES gives a good illustration in a recent number of *Science* (xx, p. 219) of the proper meaning of the expression "once a synonym, always a synonym," which we reproduce in part. He says: "Let there be a genus *Smithia* in botany. Let a genus *Jonesia* then be named. Let *Jonesia* then be found to be the same genus as *Smithia.* Then the name *Jonesia* 'lapses into synonymy' and can not be thereafter applied *to any other genus* in botany. Exactly the same principle holds for all specific names within their respective genera. Example: Let there be a *Rosa Smithi.* Let some one then name a *Rosa Jonesi.* Let *R. Jonesi* be considered to be the same species as *R. Smithi.* Then there can never be a *R. Jonesi;* that is to say, *no other species* of *Rosa* can be specified as *R. Jonesi.* But, of course, if any one discovers, after this reduction of *Jonesi* to a synonym of *Smithi,* that what had been called *R. Jonesi* is a good species, then *Jonesi* revives as the name of *that* species; and the fact that it had been (erroneously) regarded as a synonym of *Smithi* is no bar to its use in its original sense."

GENERAL INDEX.

*** The more important classified entries will be found under the following heads: *Diseases, Floras, Journals, Personals, Reviews.*

*** Names of synonyms are printed in *Italics;* names of new species in **bold-face;** † signifies death.

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